2.0 METHODS

This section describes the methods and analytical tools used to evaluate each of the four Options in relation to each of the 17 evaluation criteria (see Section 1.5). This section includes a description of how ecological stressors and impact mechanisms on fish were defined, ranked, and used in the evaluation of the Options and how the level of certainty was defined; a description of methods for conducting the hydrodynamic modeling of each of the Options and rationale for addition of pump facility to Option 2; description of the methods used to evaluate the performance of Options in addressing biological criteria, including descriptions of the metrics, tools, scales, and assumptions used; and methods used to evaluate the performance of Options in addressing the planning, flexibility/durability/sustainability, and other resource impacts criteria.

2.1 COVERED FISH SPECIES STRESSORS

Stressors and stressor impact mechanisms were the primary tool used to conduct the evaluation of each Option relative to the biological criteria. The BDCP uses the following definitions of species stressors and impact mechanisms:

- **Species Stressor –** An ecological/environmental condition that reduces the production (reproduction, growth, and survival), abundance, or distribution of the species.
- **Species Stressor impact mechanism** – A physical or biological process that triggers a species stressor. If the magnitude of an impact mechanism is changed (positively or negatively), the effect of the stressor on the species would change (positively or negatively).

The stressors were identified for the covered fish species through the BDCP process. The stressors and their underlying impact mechanisms were derived from information gathered in BDCP technical sessions with species experts during the spring and summer of 2007. Based on published and unpublished literature and best professional judgment of species experts, the stressors for each species were ranked in the following categories:

- **Highly important stressors:** Stressors that, if reduced or eliminated, would likely result in a sustained increase in species production, abundance, or distribution throughout a large segment of the species range.
- **Moderately important stressors:** Stressors that, if reduced or eliminated, would likely result in increased species production, abundance, or distribution, but at a lesser scale than for the highly important stressors.
- **Other stressors:** Stressors that are currently known or for which the available information indicate are likely to adversely affect individuals of the species, but which are not likely to affect the species at a population level.

- **Stressors that could be manifested in the future:** Environmental attributes or conditions that might affect the abundance and distribution of the species in the future. These stressors, which are applicable to each of the covered species, include:
  - future establishment of non-native competitor/predator populations,
  - disease,
  - climate change (e.g., increased temperature, change in the hydrologic cycle, sea level rise), and
  - catastrophic change in the configuration of the Delta (e.g., extensive levee failures resulting from seismic events).

The degree to which each Option would increase or decrease each of the stressors for each fish species was the key element of the evaluation. A description of the impact mechanism(s) by which effects would occur is provided in the narrative section of the evaluation. The evaluation focused on highly important and moderately important stressors. The cause-and-effect linkages between the impact mechanisms and the stressors were used to evaluate the anticipated range of responses of the covered fish species under each of the Options in relation to the seven biological evaluation criteria. The primary focus of the evaluation was on how each of the Options affected the highly important and moderately important stressors for each of the species because reductions in these stressors are expected to result in population-level benefits. The relationship among highly and moderately important stressors, their primary impact mechanisms, and the certainty of the cause and effect linkage between impact mechanisms and stressors are illustrated in Figures 2-1 to 2-9 for each of the covered species. Detailed descriptions of the stressors, their impact mechanisms, and other supporting information are presented in Appendix C.

The certainty of the predicted effects of each Option on species was also evaluated, and is provided in the narrative discussion and summary tables. Level of certainty was based on the following definitions[1]:

4 = High certainty: Understanding of the stressor and its impact mechanisms is high based on information provided in the scientific literature and input provided by species experts. Stressor effects are well-understood and largely predictable.

3 = Moderate certainty: Understanding of the stressor and its impact mechanisms is high but the nature of stressor effects is dependent on other highly variable ecosystem processes or uncertain external factors, or understanding of the stressor and its impact mechanisms is moderate. Stressor effects are well-understood and largely predictable. Certainty assessment is based on information provided in the scientific literature and input provided by species experts.

[1] Adapted from certainty categories for ecological outcomes presented in the draft DRERIP Vetting Worksheet dated July 30, 2007.

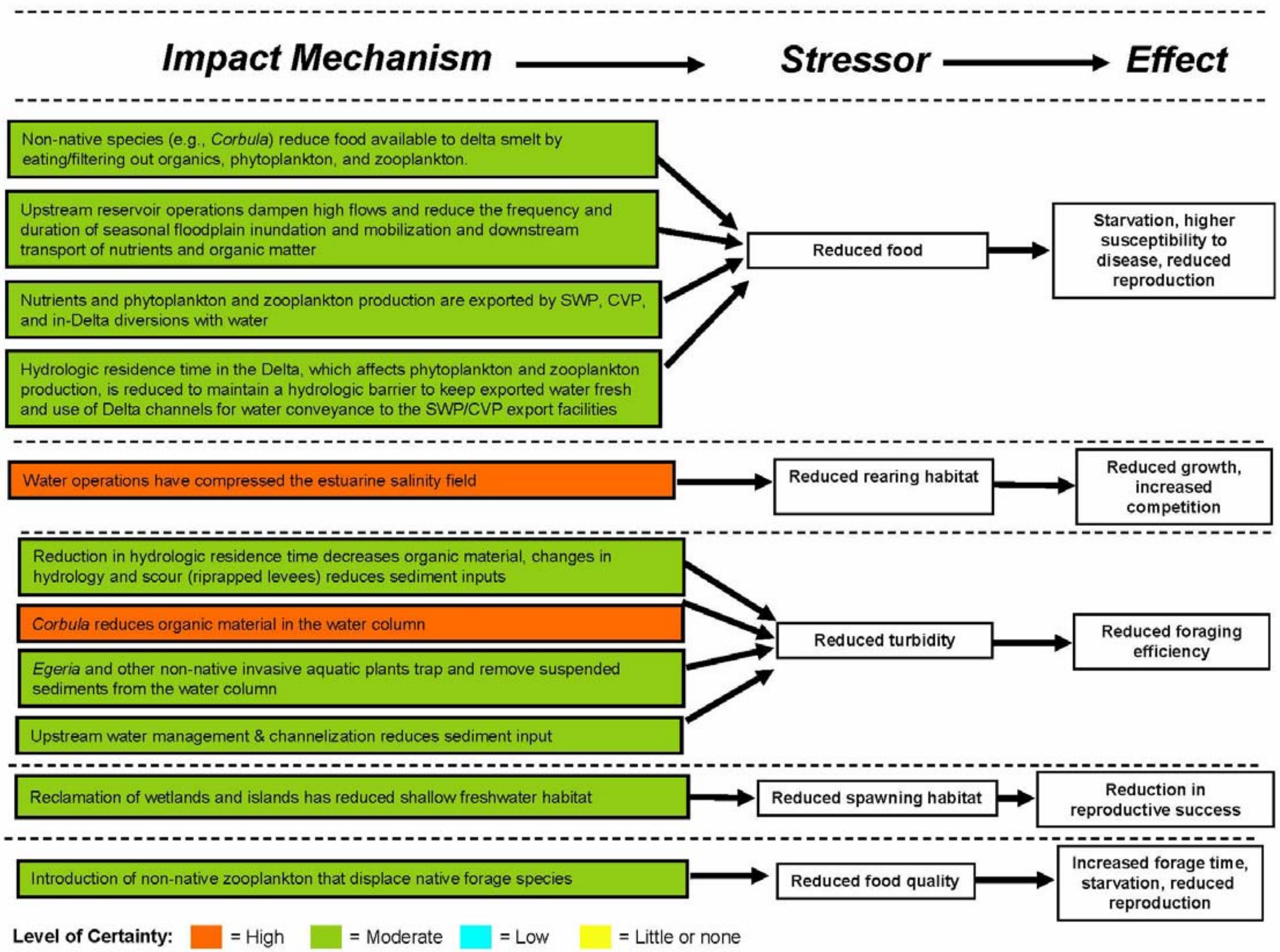

Figure 2-1a. Highly Important Delta Smelt Impact Mechanisms, Stressors, and Effects

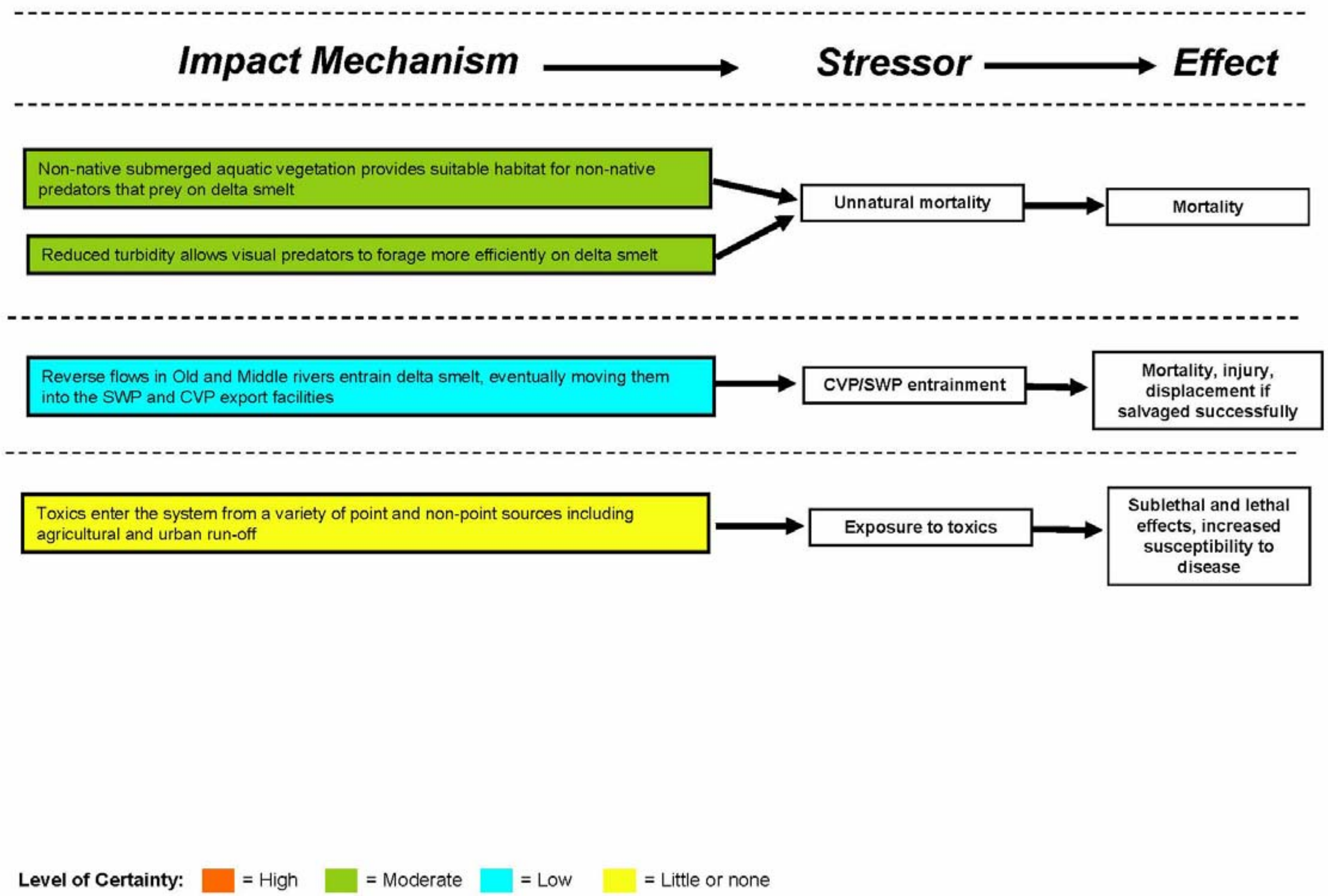

Figure 2-1b. Moderately Important Delta Smelt Impact Mechanisms, Stressors, and Effects

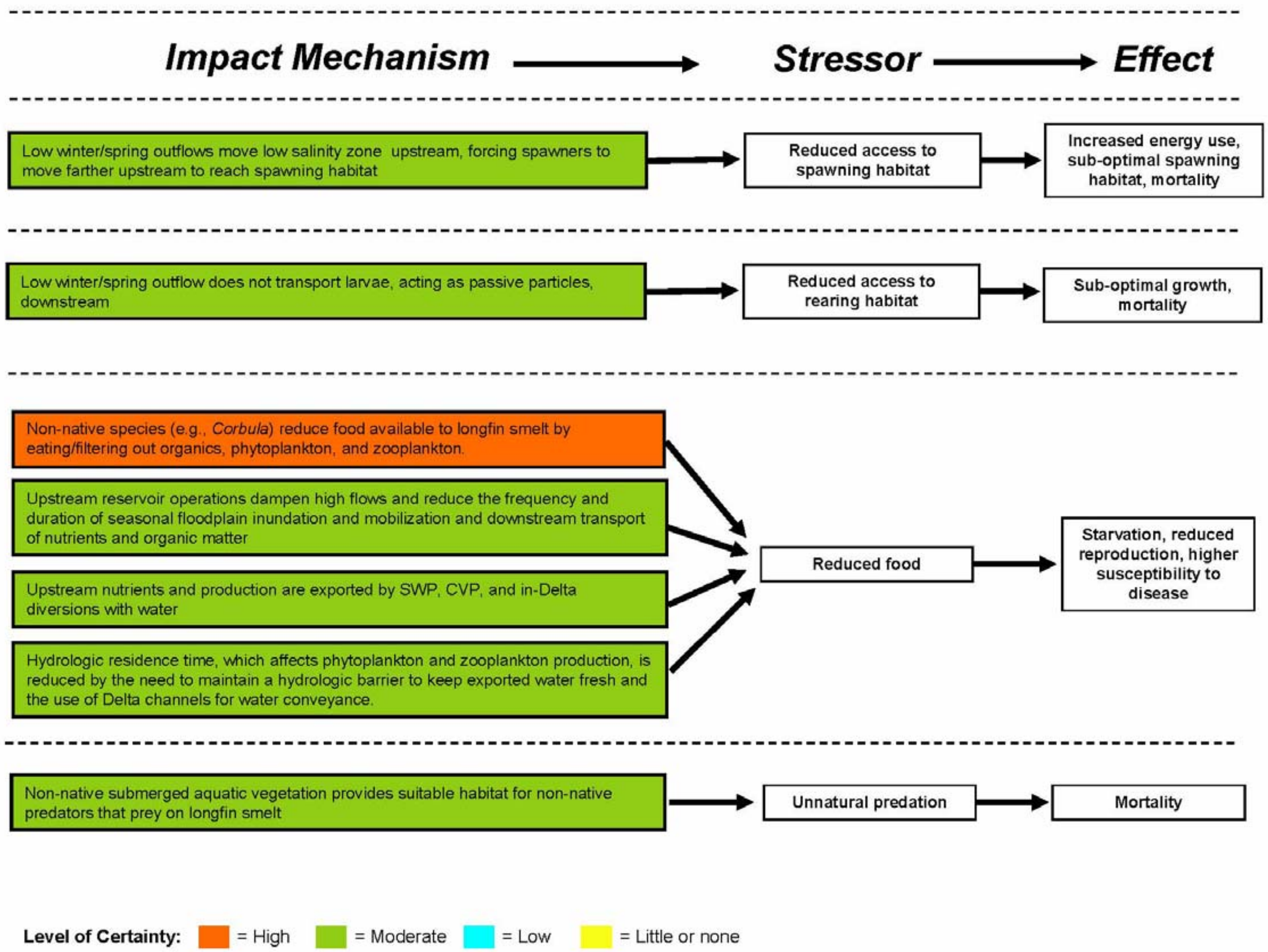

Figure 2-2a. Highly Important Longfin Smelt Impact Mechanisms, Stressors, and Effects

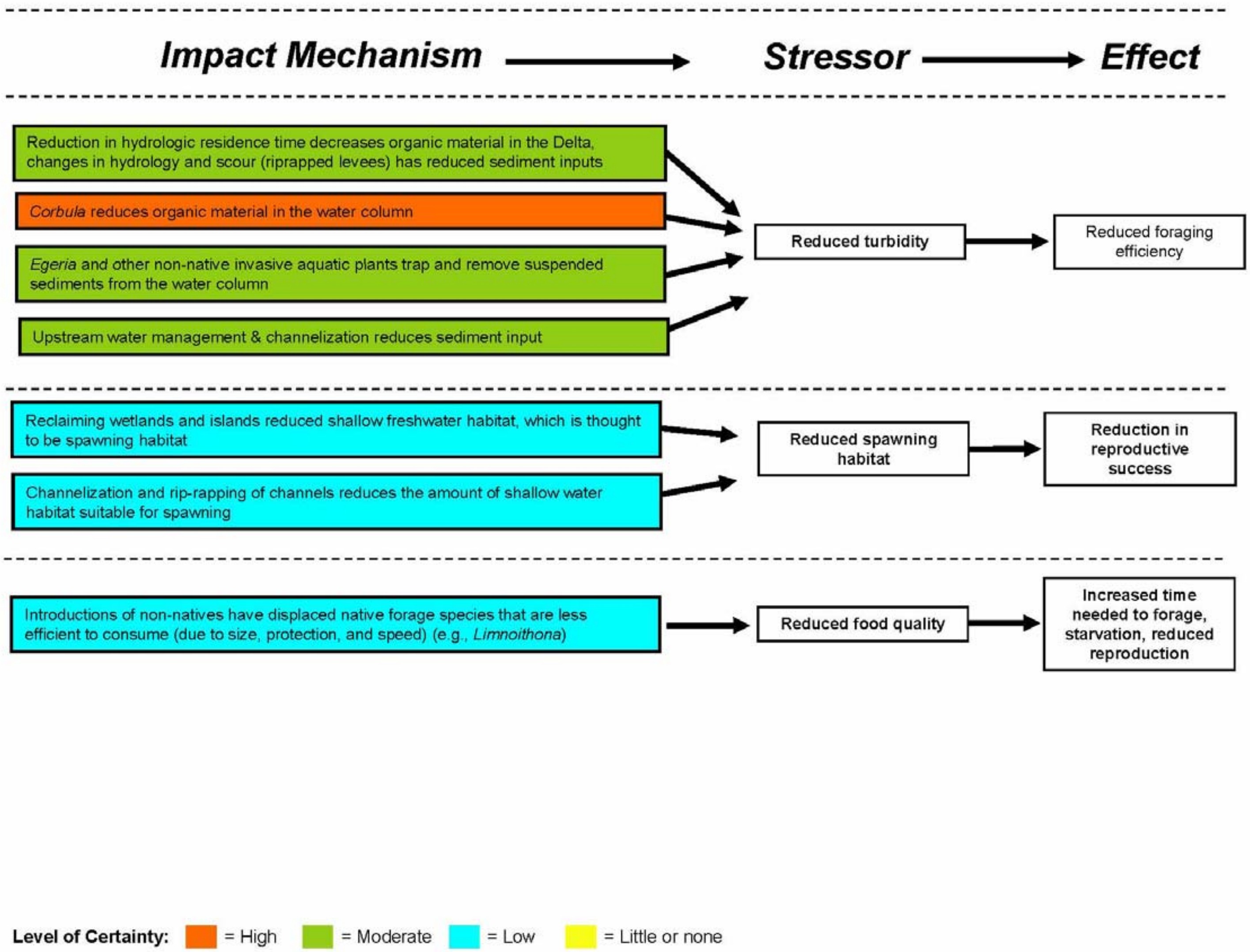

Figure 2-2b. Highly Important Longfin Smelt Impact Mechanisms, Stressors, and Effects

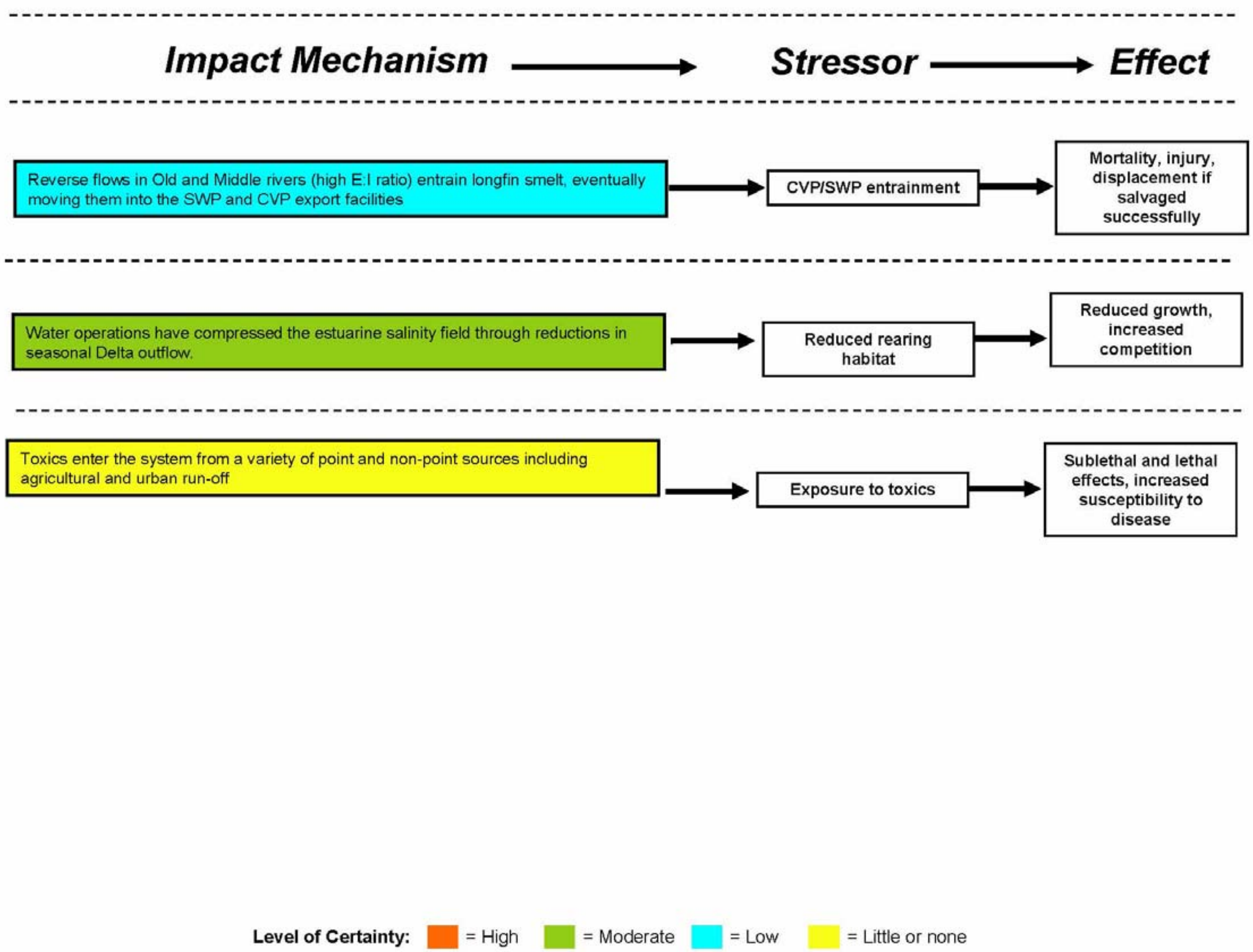

Figure 2-2c. Moderately Important Longfin Smelt Impact Mechanisms, Stressors, and Effects

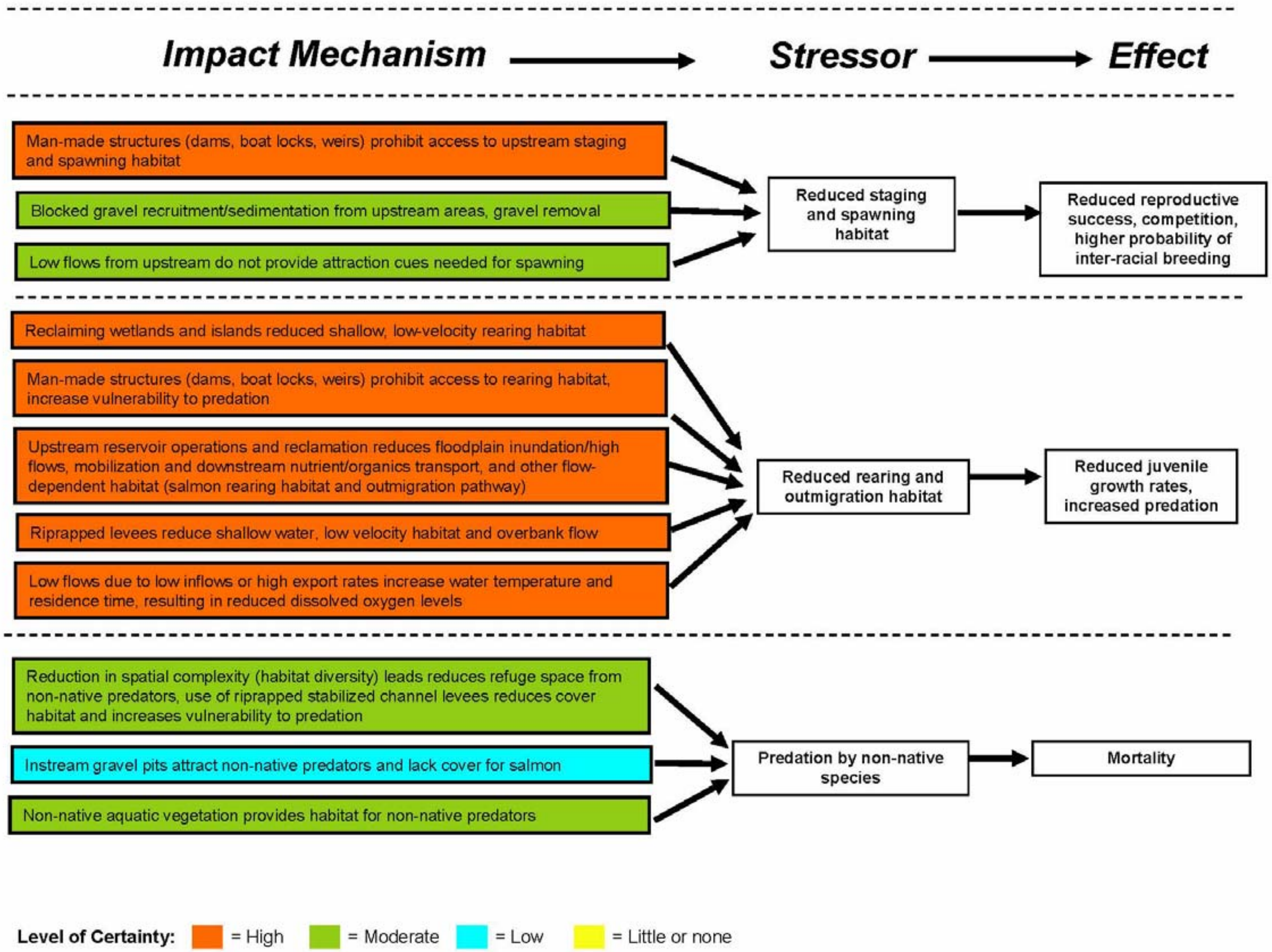

Figure 2-3a. Highly Important Sacramento River Chinook Salmon Impact Mechanisms, Stressors, and Effects

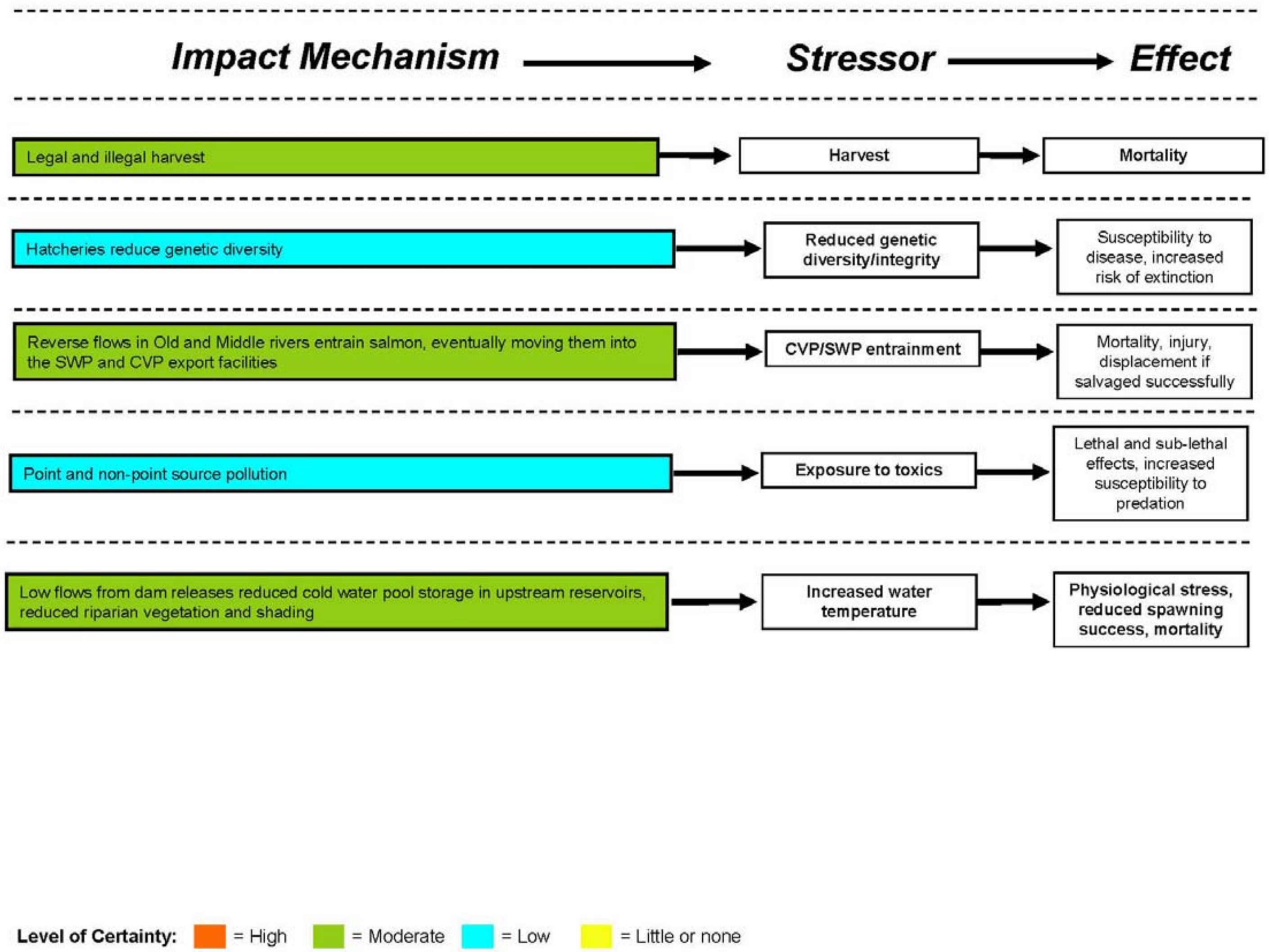

Figure 2-3b. Moderately Important Sacramento River Chinook Salmon Impact Mechanisms, Stressors, and Effects

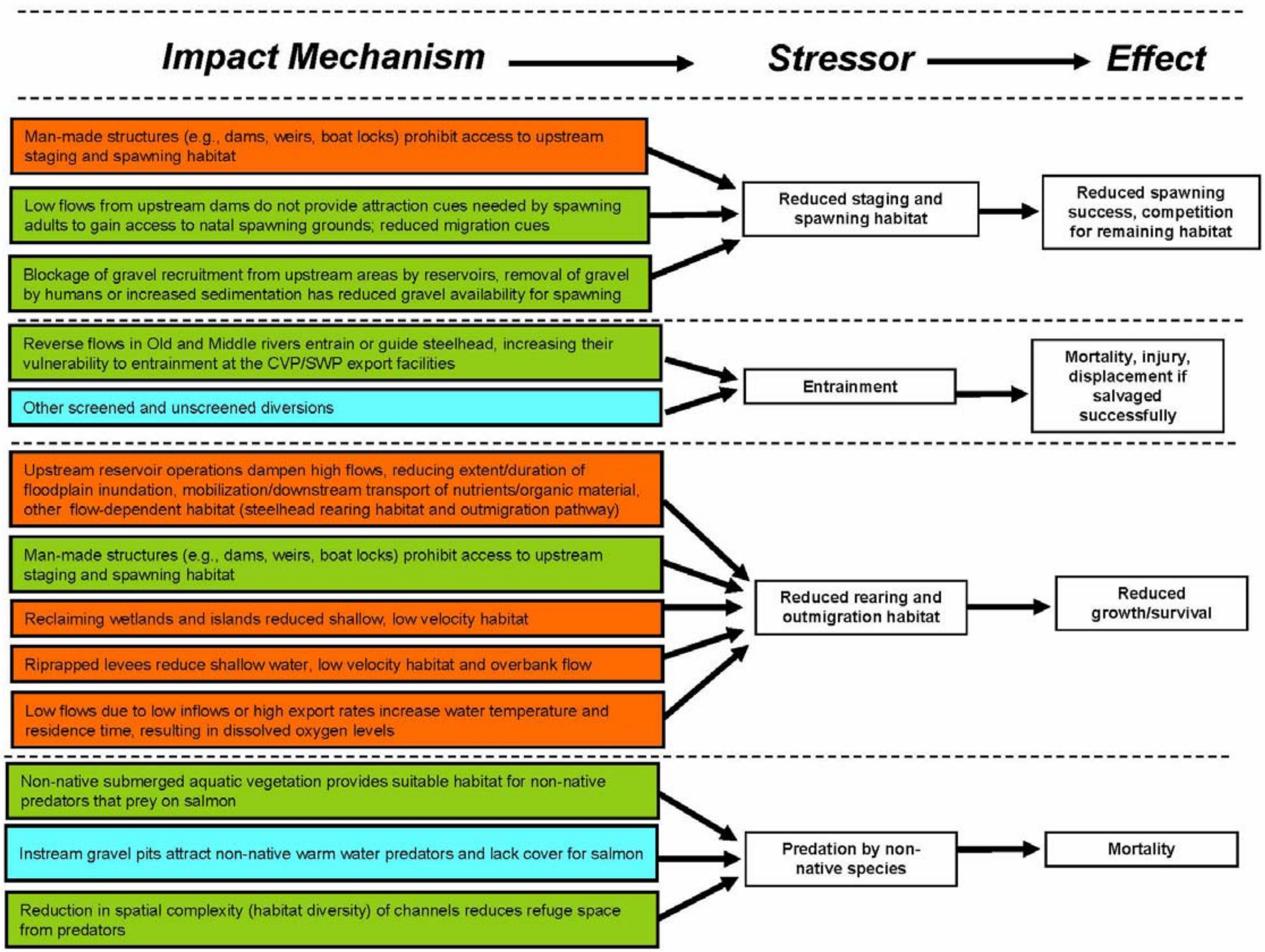

Figure 2-4a. Highly Important Sacramento River Steelhead Impact Mechanisms, Stressors, and Effects

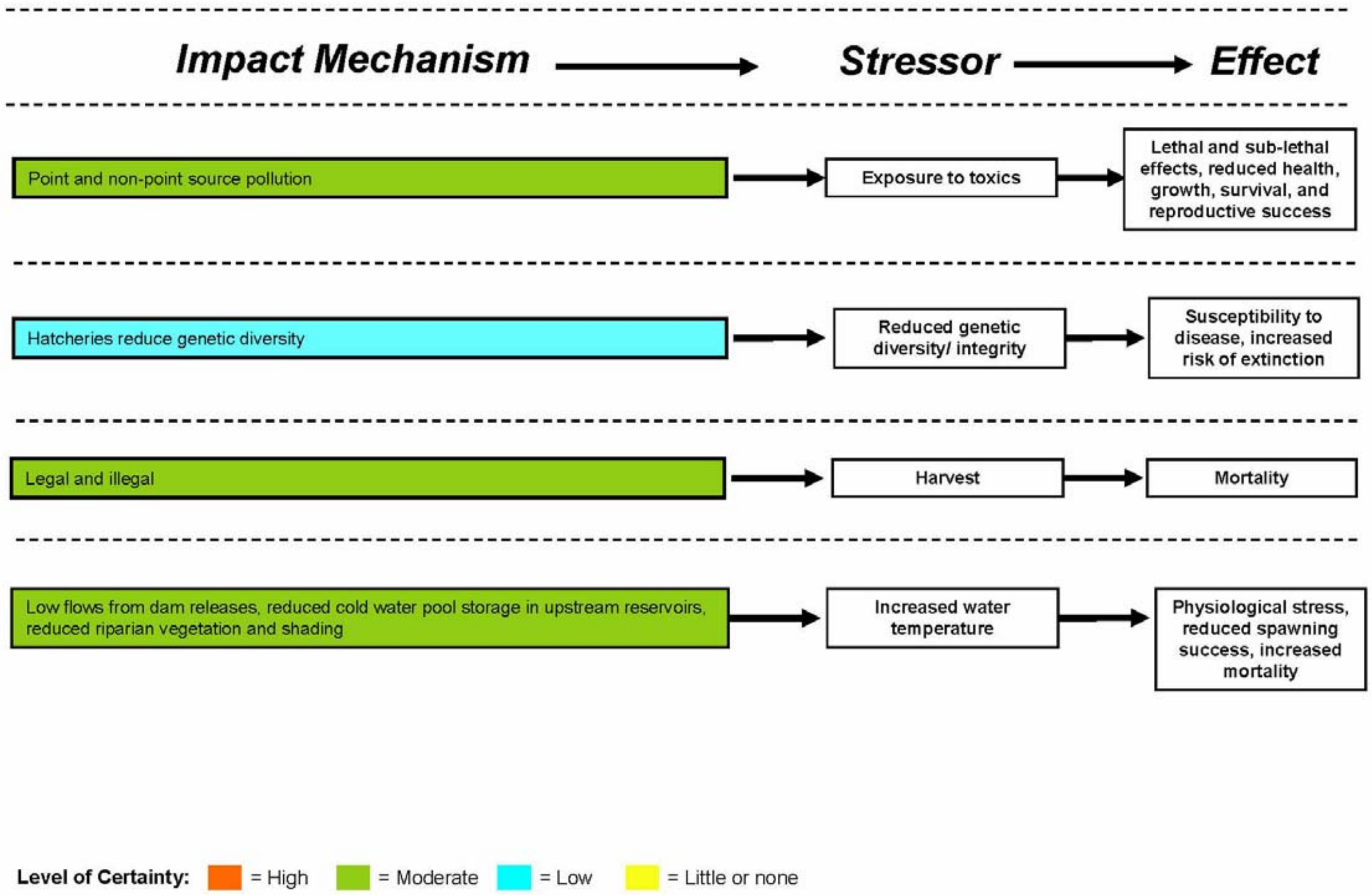

Figure 2-4b. Moderately Important Sacramento River Steelhead Impact Mechanisms, Stressors, and Effects

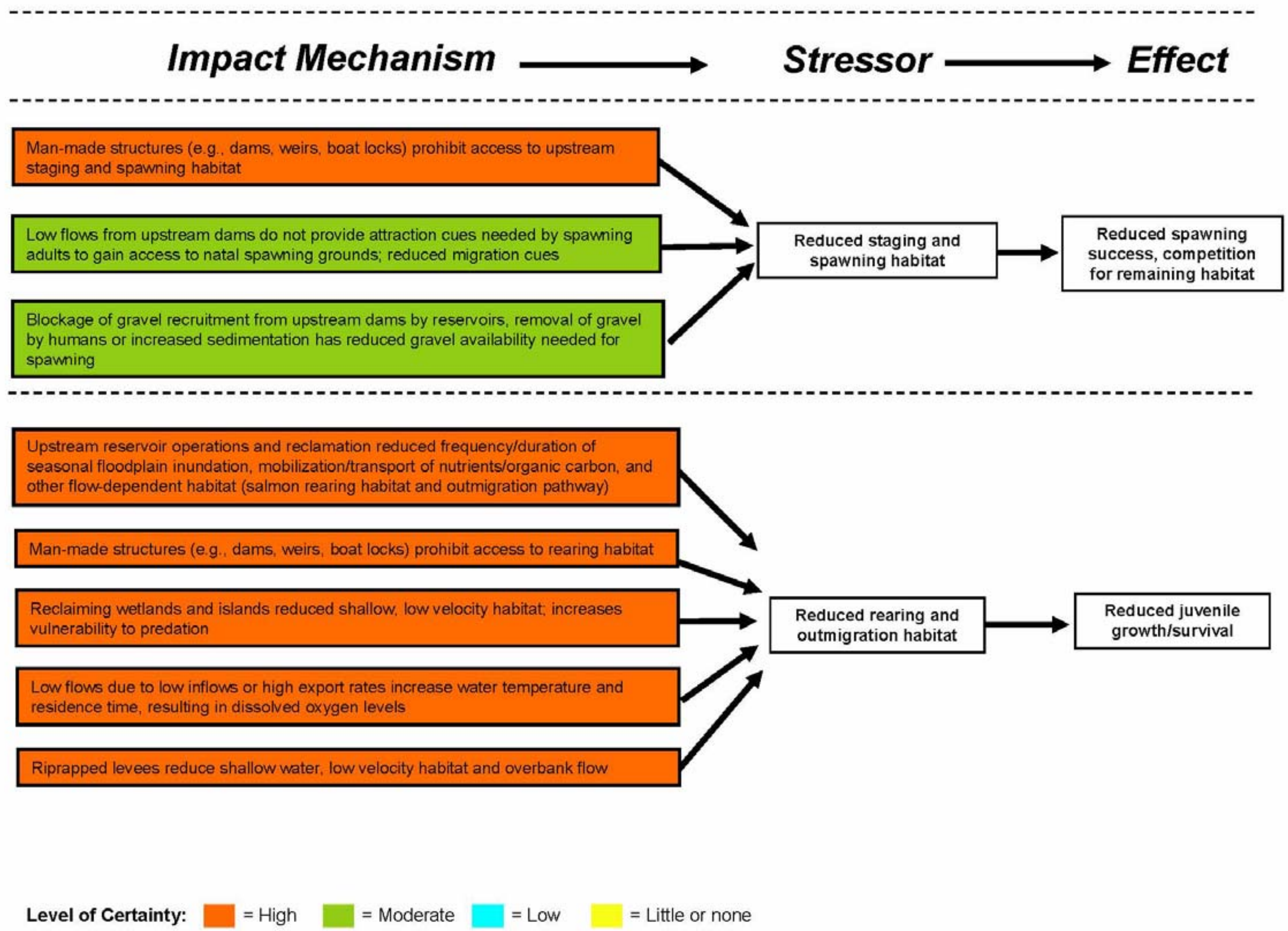

Figure 2-5a. Highly Important San Joaquin River Chinook Salmon Impact Mechanisms, Stressors, and Effects

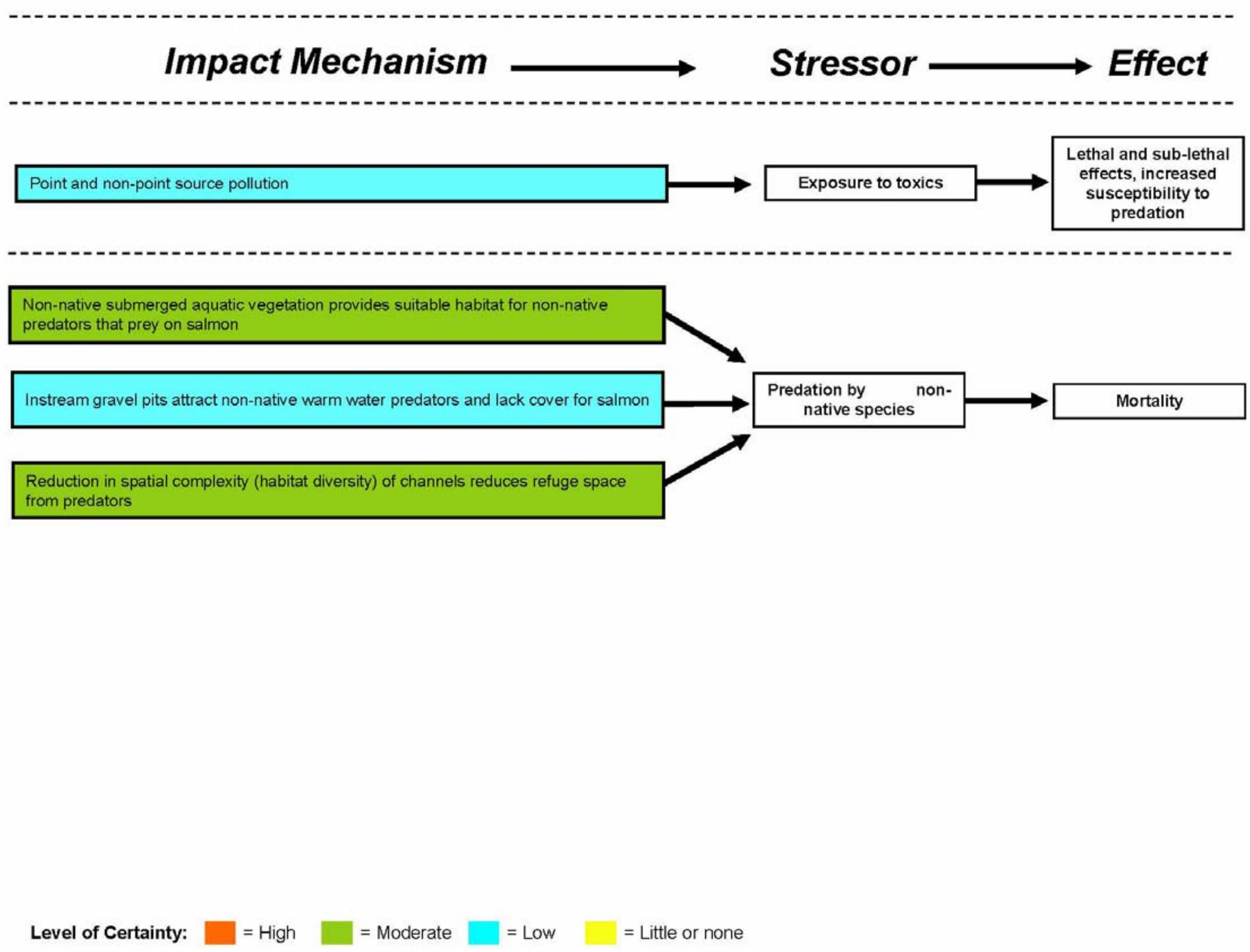

Figure 2-5b. Highly Important San Joaquin River Chinook Salmon Impact Mechanisms, Stressors, and Effects

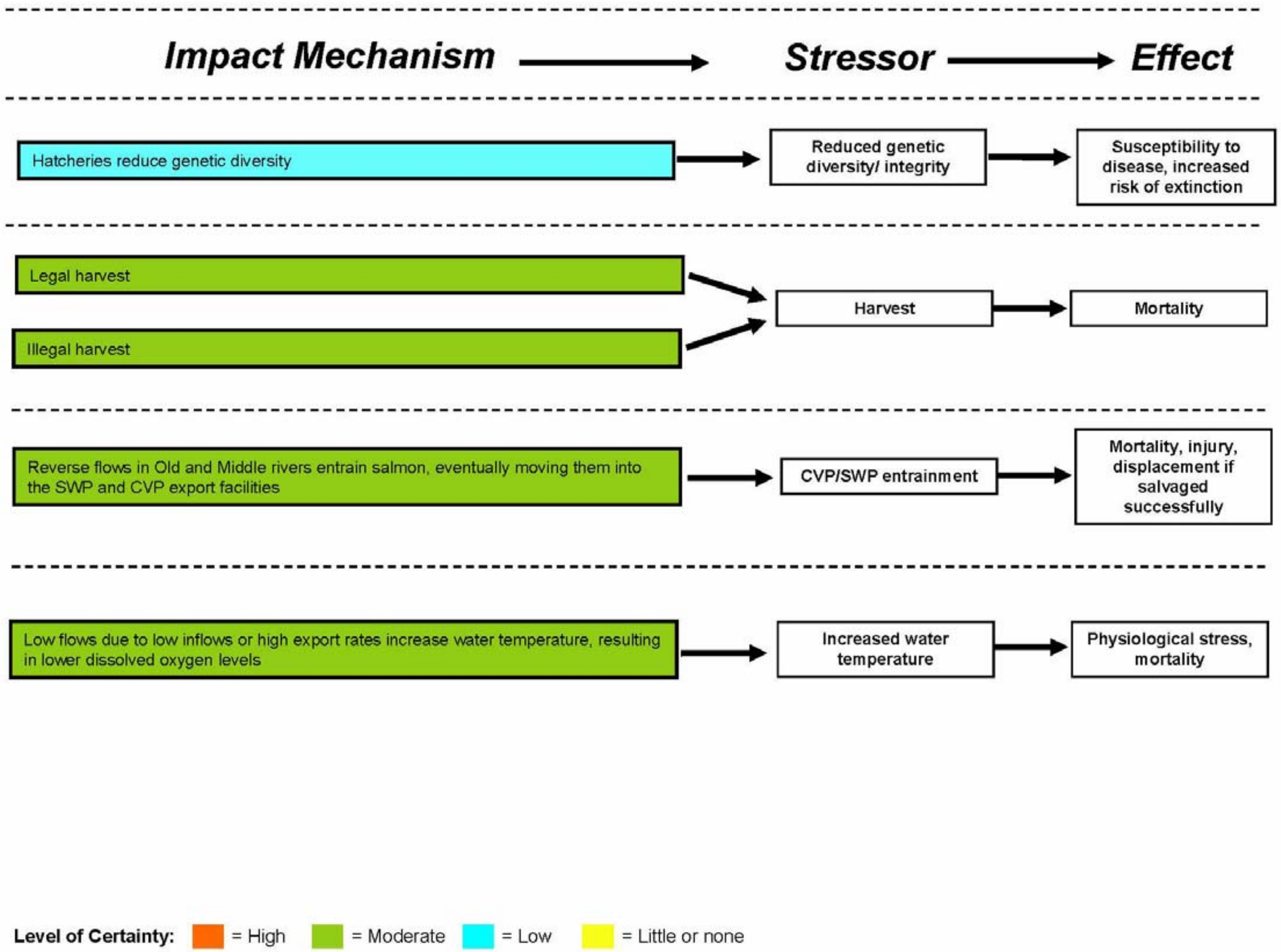

Figure 2-5c. Moderately Important San Joaquin River Chinook Salmon Impact Mechanisms, Stressors, and Effects

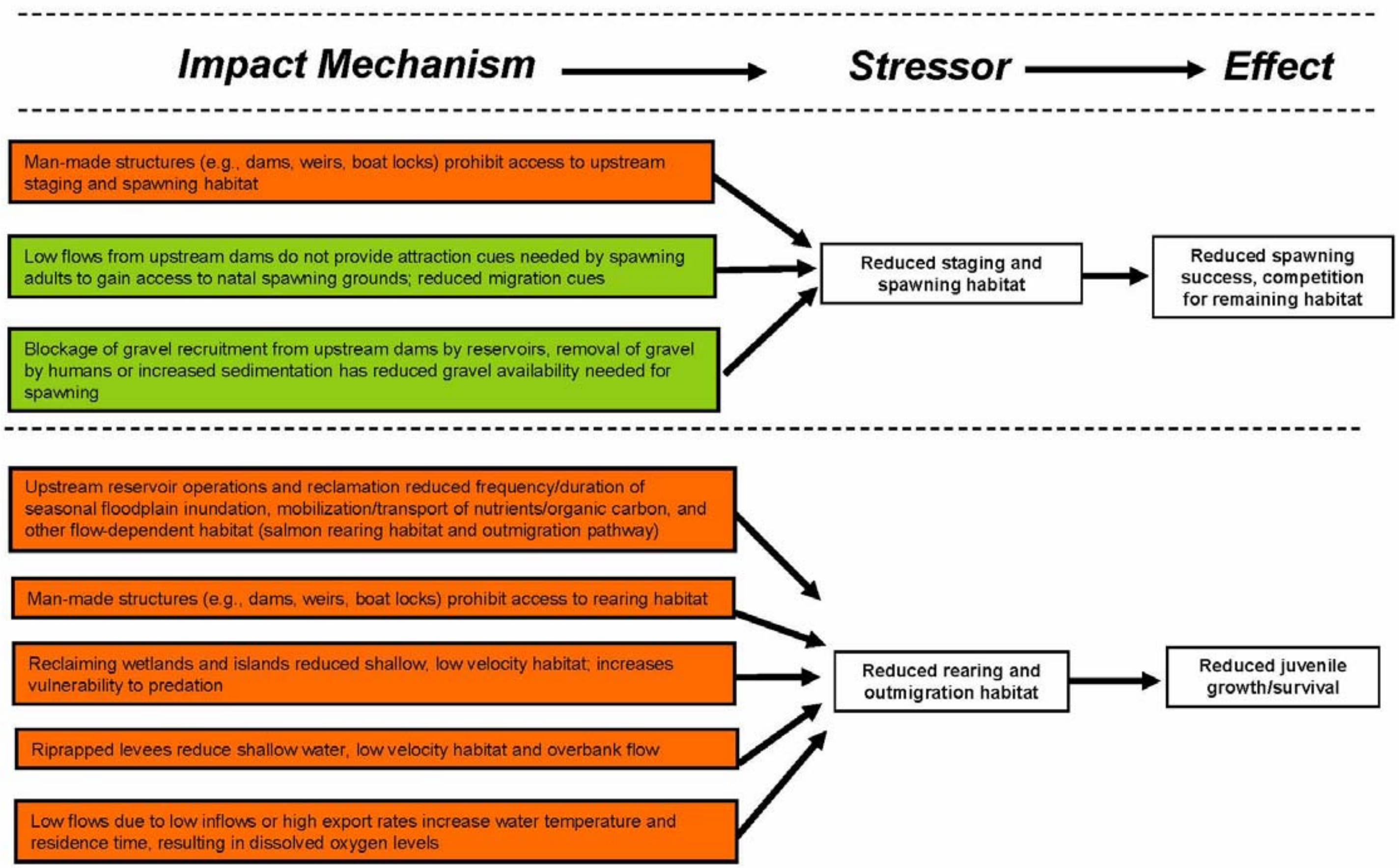

Figure 2-6a. Highly Important San Joaquin River Steelhead Impact Mechanisms, Stressors, and Effects

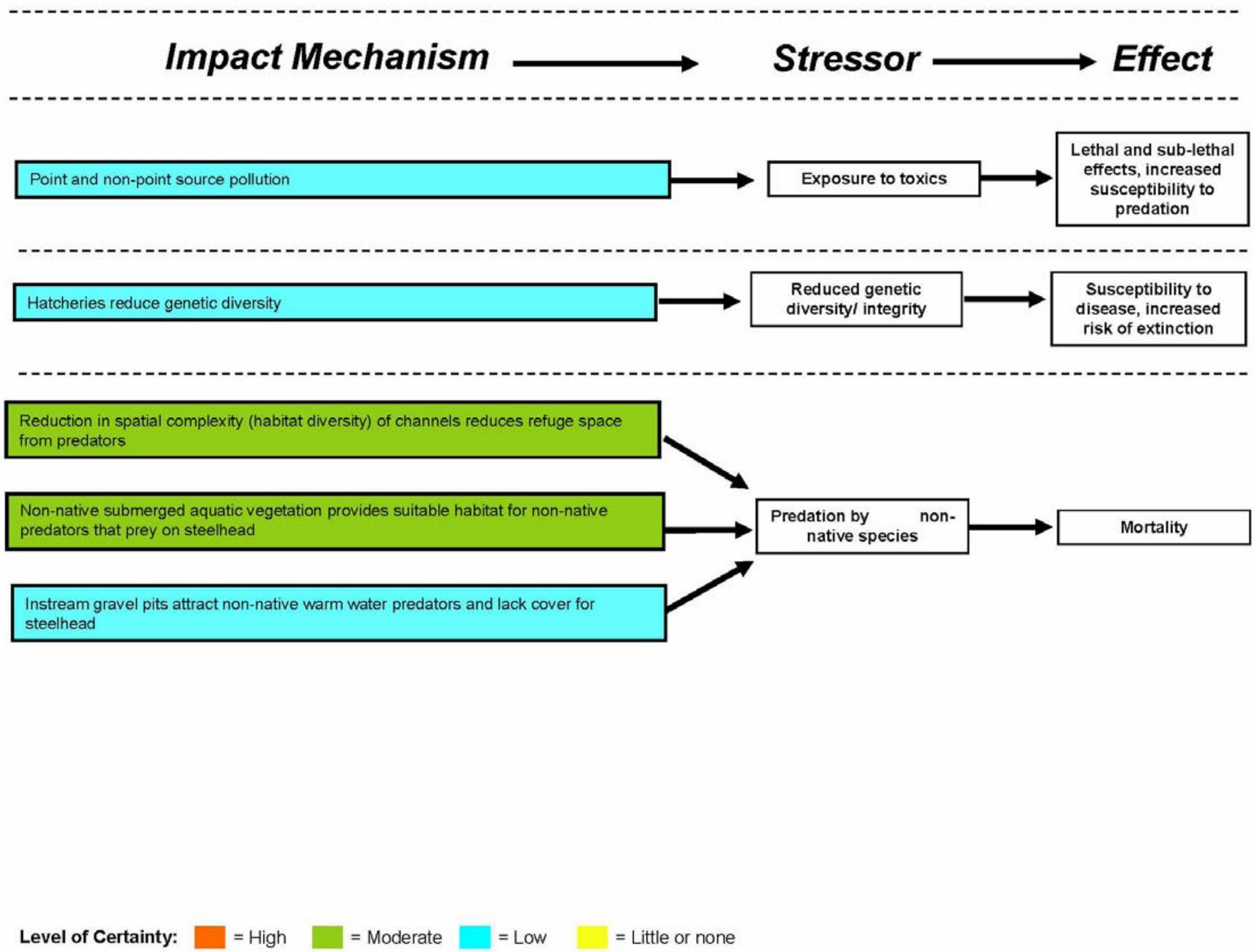

Figure 2-6b. Highly Important San Joaquin River Steelhead Impact Mechanisms, Stressors, and Effects

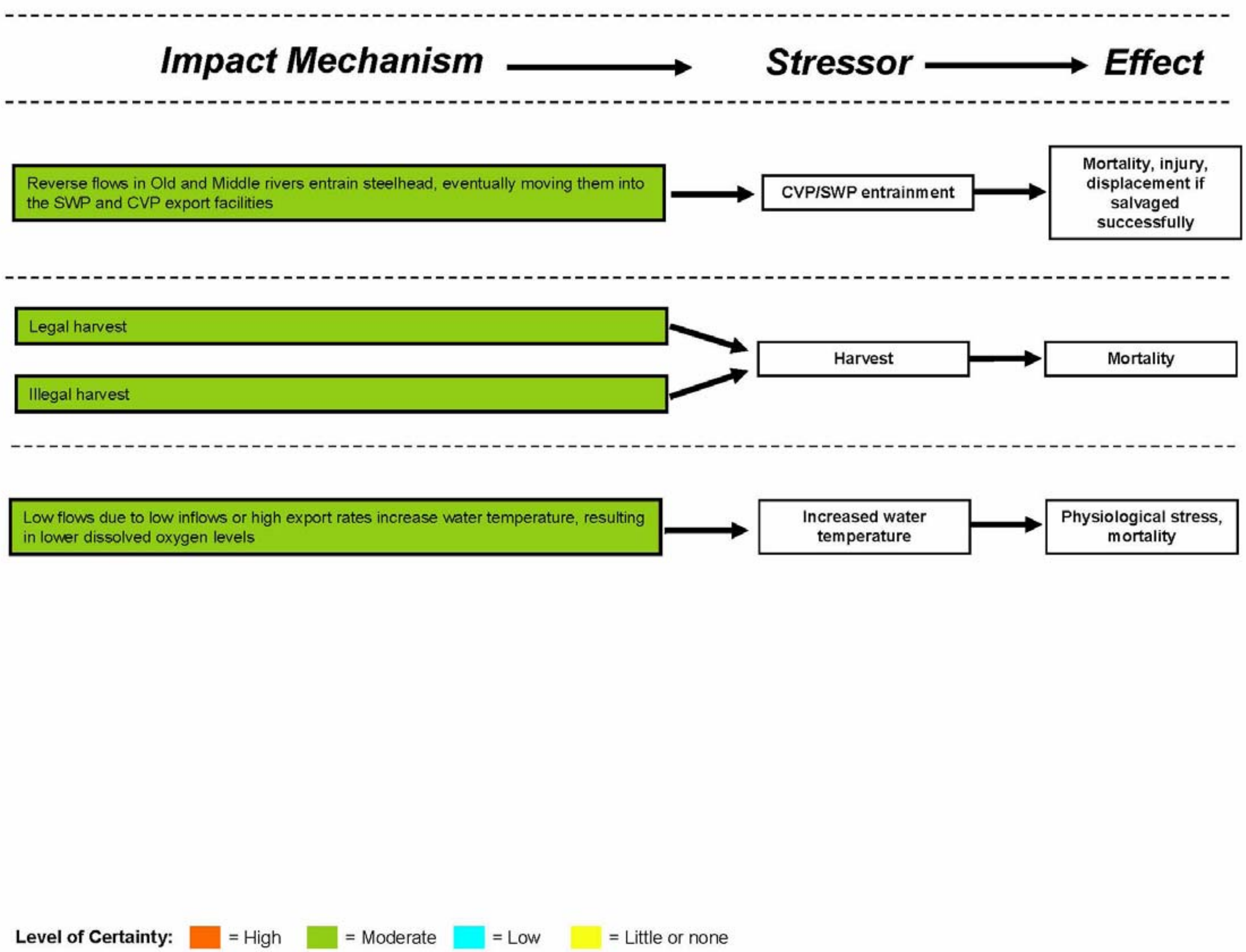

Figure 2-6c. Moderately Important San Joaquin River Steelhead Impact Mechanisms, Stressors, and Effects

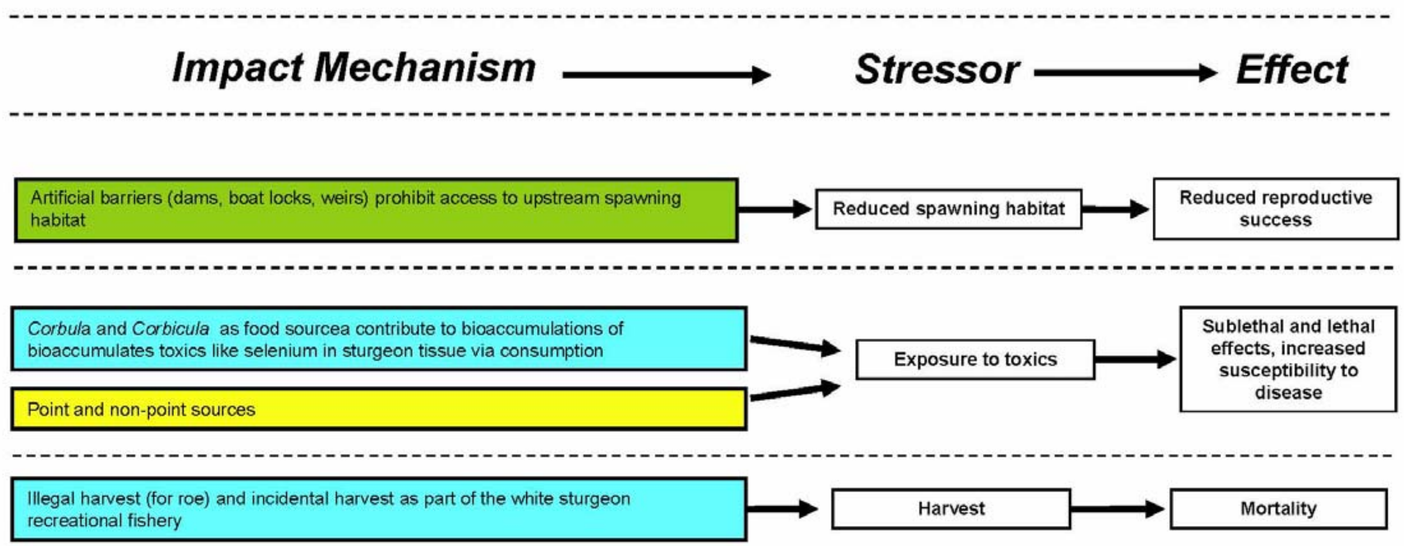

Figure 2-7a. Highly Important Green Sturgeon Impact Mechanisms, Stressors, and Effects

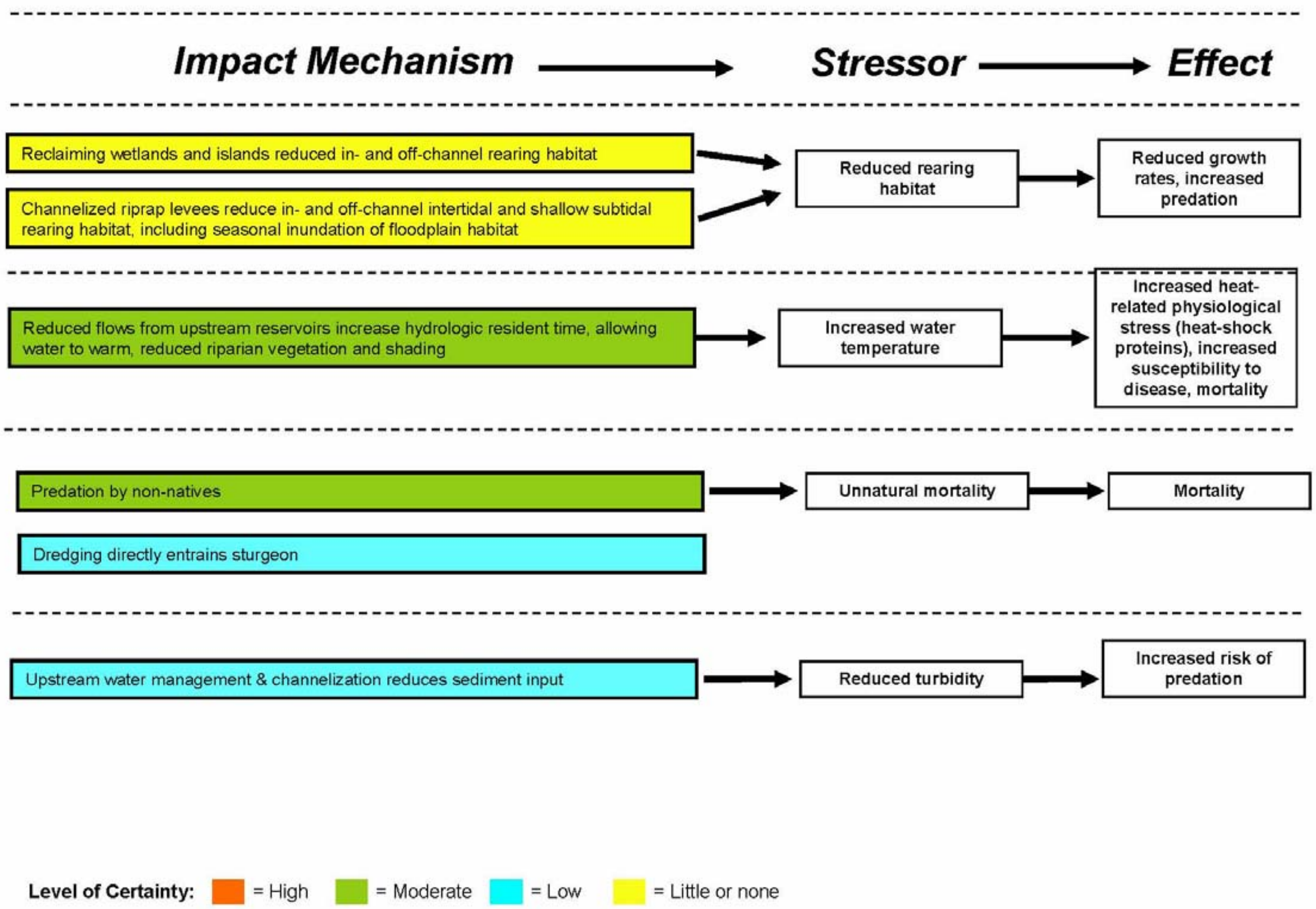

Figure 2-7b. Moderately Important Green Sturgeon Impact Mechanisms, Stressors, and Effects

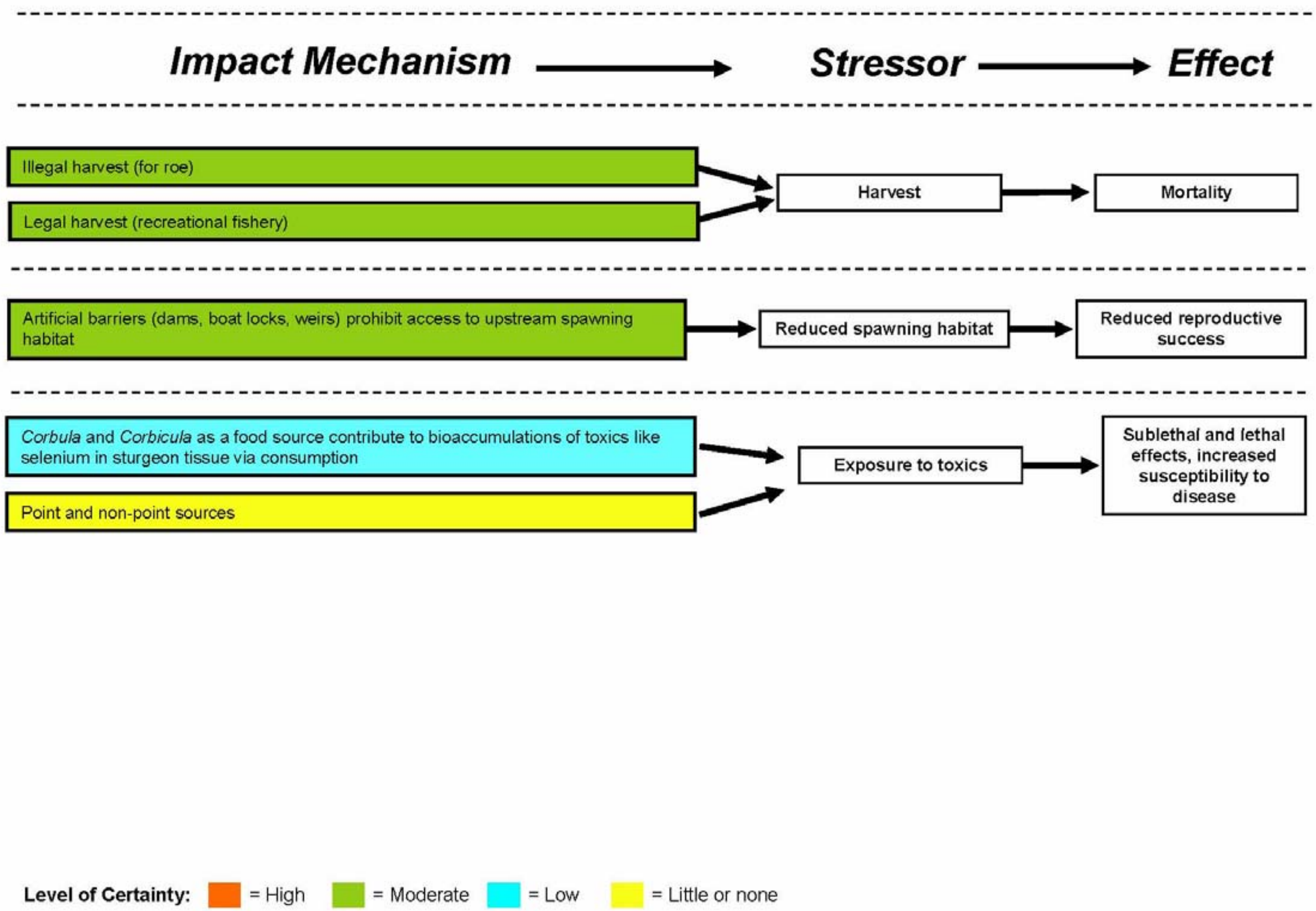

Figure 2-8a. Highly Important White Sturgeon Impact Mechanisms, Stressors, and Effects

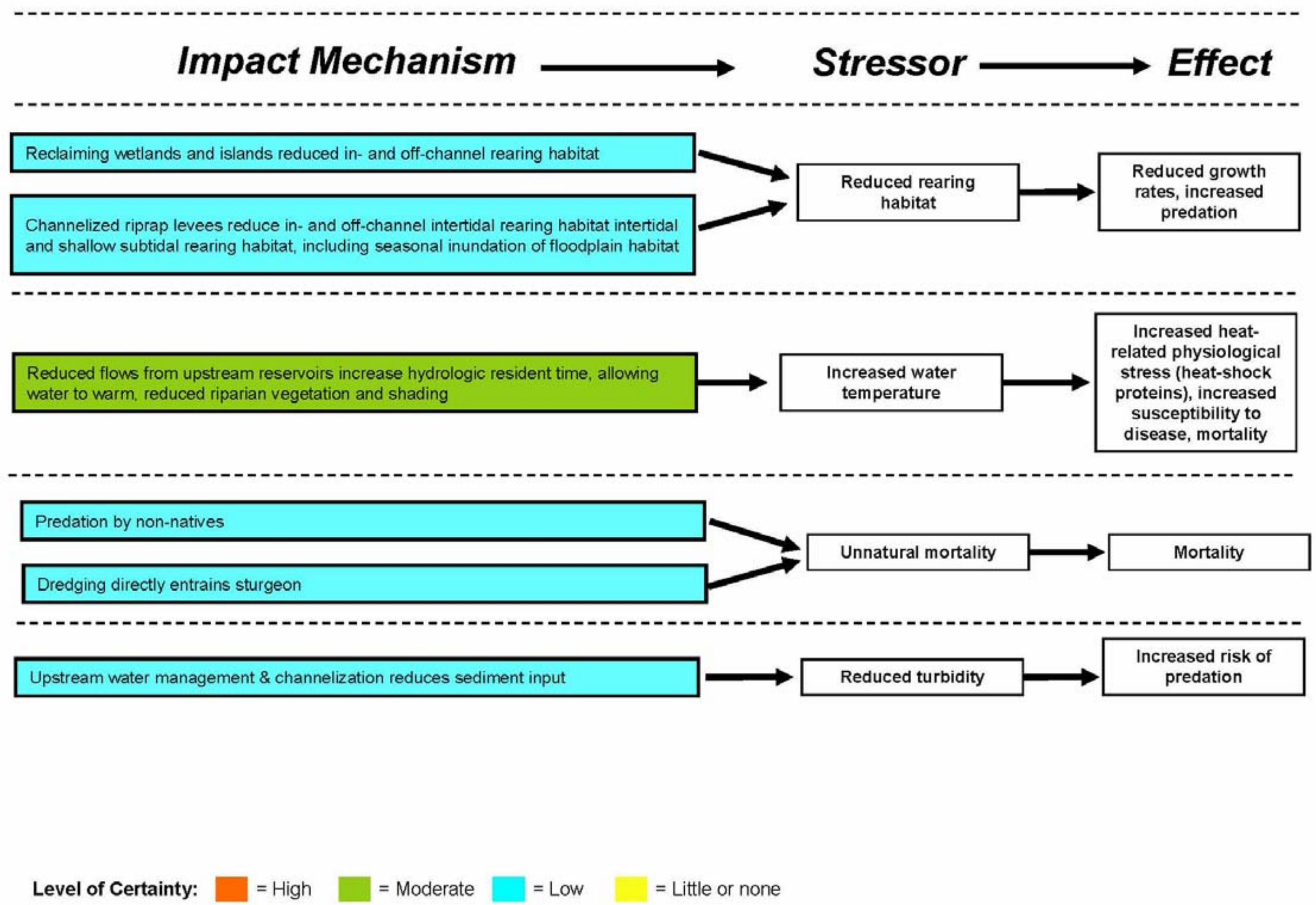

Figure 2-8b. Moderately Important White Sturgeon Impact Mechanisms, Stressors, and Effects

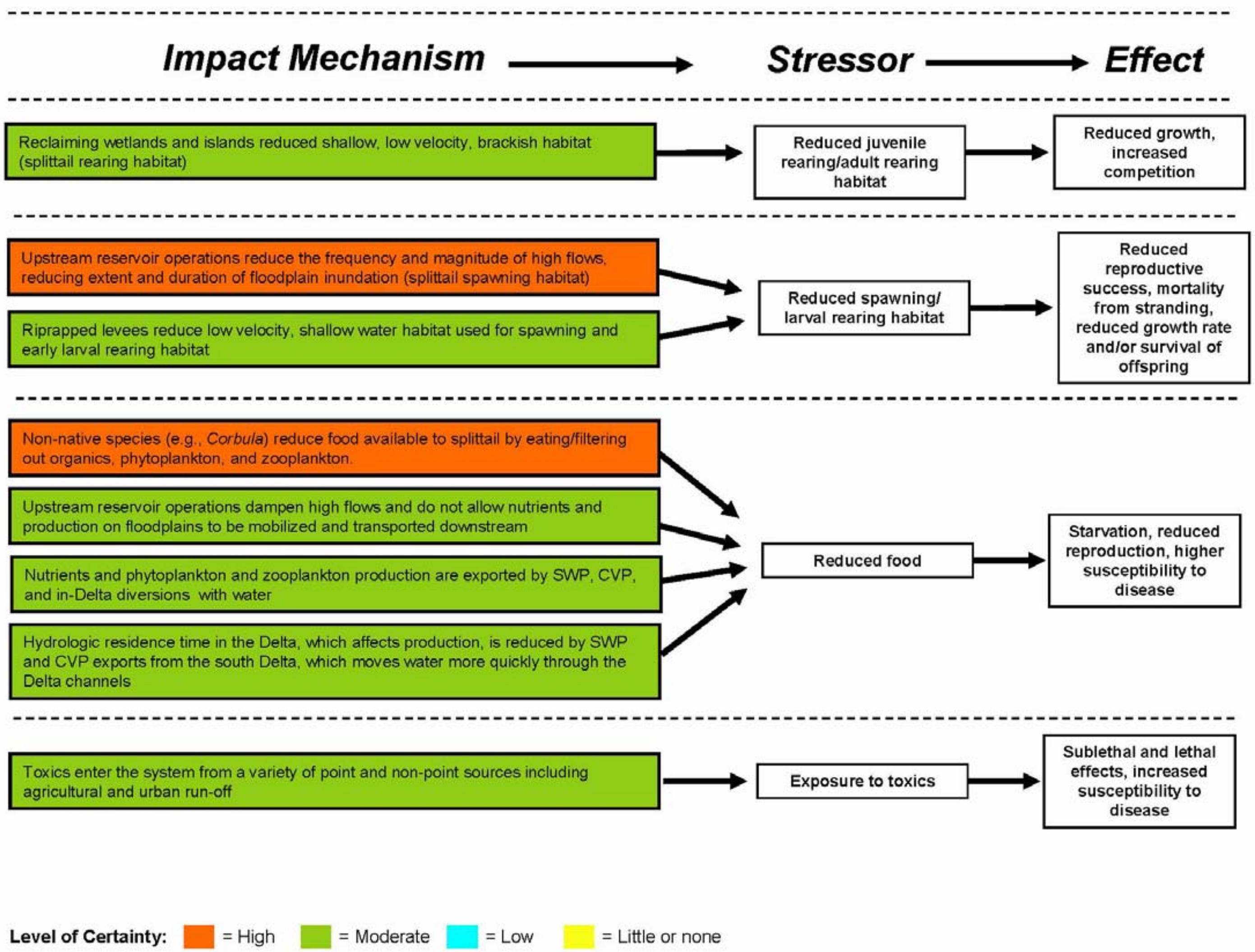

Figure 2-9a. Highly Important Sacramento Splittail Impact Mechanisms, Stressors, and Effects

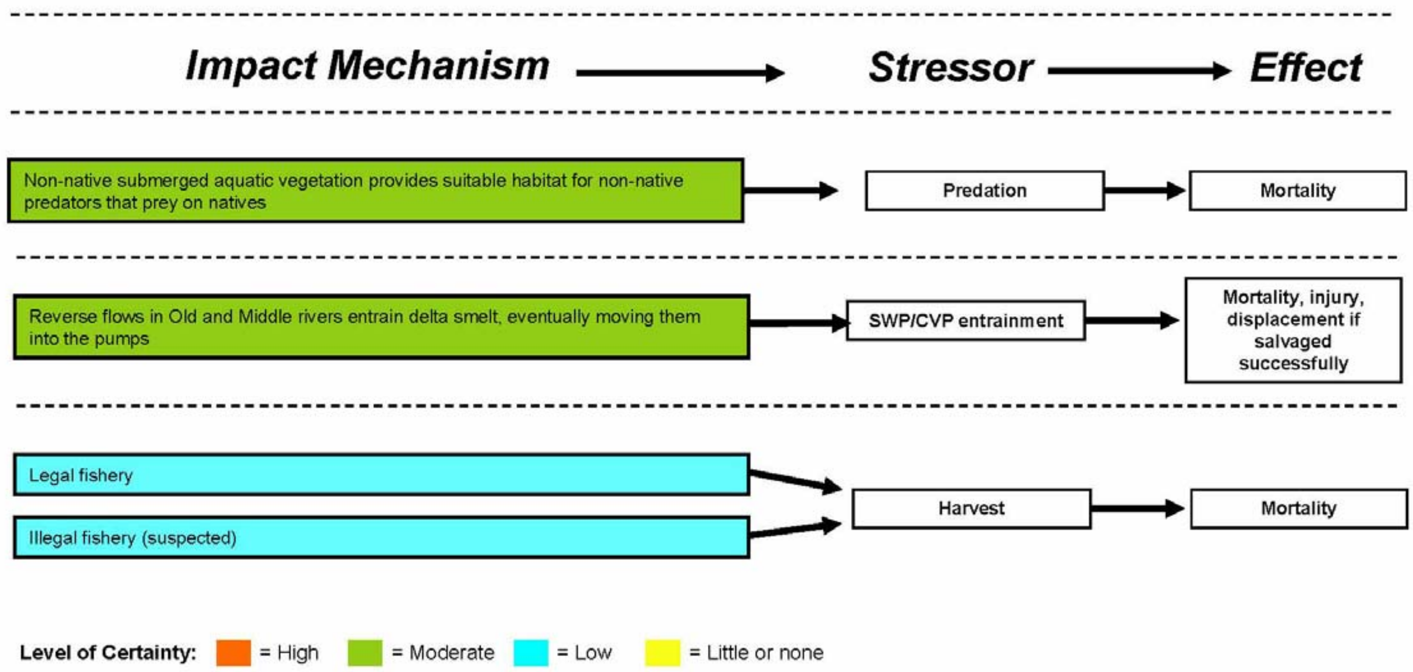

Figure 2-9b. Moderately Important Sacramento Splittail Impact Mechanisms, Stressors, and Effects

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2 = Low certainty: Understanding of the stressor and its impact mechanisms is moderate. Stressor effects generally cannot be predicted, or understanding of the stressor and its impact mechanisms is low. The nature of stressor effects is largely predictable based on information provided in the scientific literature and input provided by species experts.

1 = Little or no certainty: Understanding of the stressor and its impact mechanisms is lacking (scientific basis unknown or not widely accepted), or understanding of the stressor and its impact mechanisms is low. The nature of stressor effects is generally not predictable.

2.2 HYDROLOGIC/HYDRODYNAMIC MODELING

This section describes the hydrologic and hydrodynamic modeling approach, tools, and assumptions that were applied to provide information for evaluation of the Options. Hydrologic/system operations, hydrodynamic, and water quality modeling was performed to provide information on Delta flows, CVP/SWP operations and exports, Delta circulation patterns, and water quality effects in a response to the assumptions and criteria applied under each of the Options. The modeling information was used, in part, to assist in the overall evaluation of the Options. The modeling performed for this evaluation report should be considered "screening-level", consistent with the objectives and timeframe for this report.

2.2.1 Analytical Process and Modeling Approach

The overall analytical process applied in the hydrodynamic modeling evaluation of the Options is shown in Figure 2-10. Two main models, CALSIM II and DSM2, were used to evaluate a range of operations and response within each Option. These models and their applications and uses are described in Appendix A. Operational parameter assumptions, consisting of flow requirements/restrictions, water quality targets, and facility operational criteria, were developed by the consultant team, in consultation with the Steering Committee, to provide a range of responses within each Option. The range of operations under each Option is represented in the modeling as "A" and "B" scenarios. The "A" scenario generally represents the less restrictive conditions for water supply while the "B" scenario represents a more restrictive condition for water supply. Parameter values for scenarios A and B used in the modeling for each of the Options is presented in Appendix B.

The CALSIM II model was used to evaluate the hydrologic and system response of each Option over a wide range of hydrologic conditions. CALSIM II was simulated on a monthly time step for 82 years (water years 1922 to 2003) to provide output for parameters such as river flows, exports, water supply impacts, reservoir storage conditions, and system controls. The output from the CALSIM II modeling, in addition to other necessary boundary conditions, was used to drive the DSM2 set of models to evaluate the hydrodynamic, water quality, and particle transport and fate conditions. The DSM2-HYDRO and DSM2-QUAL models were simulated on a 15-minute time step for a 16 year period (water years 1976 to 1991) to provide output of channel flows, velocities, stage, and water quality (electrical conductivity). Finally, the DSM2-PTM model was simulated for three distinct months to evaluate particle transport and fate assuming particle insertions at five different locations in the Delta.

2.2.2 Base Study Assumptions

A base condition for Delta operations was established as a reference point to specify modeling assumptions common to all Options. The base condition selected for the evaluation was current operating conditions. Current conditions were defined based on the "Existing Condition" models and assumptions currently envisioned (as of CALSIMII version 9A) in the "Common Assumptions" process. The Common Assumptions process represents a concerted effort by the California Bay Delta Authority (CBDA), the U.S. Bureau of Reclamation (Reclamation), and the California Department of Water Resources (DWR) to coordinate and implement an evaluation framework to support the common needs of the surface storage investigations.

The base condition models and assumptions include all facilities, policies, regulations, and programs in place as of June 1, 2004. Appendix B includes a detailed list of assumptions incorporated in this study. Some minor modifications to the Common Assumptions models were made as part of this evaluation report to provide for a single-step study with D-1641 Delta standards and to include QWEST and Old and Middle River flow estimates.

2.2.3 Options Assumptions

Operational parameter assumptions, consisting of flow requirements/restrictions, water quality targets, and facility operation criteria, were developed by the consultant team to provide a range of responses within each option (see Appendix B). These operational parameters were reviewed by the BDCP Steering Committee and revised based on their input. However, final model parameter inputs were developed by the consultant team to ensure that each operational scenario could function within the modeling analyses, to the extent possible, without violating upstream regulatory controls or to reconcile conflicting controls determined after initial draft simulations.

Each Option included structural and operational assumptions that were incorporated into the modeling analyses. In general the operational assumptions were based on Sacramento River flow at Rio Vista, San Joaquin River flow at Vernalis, San Joaquin River flow estimate near Jersey Point (QWEST), Middle River flow, combined Old and Middle River flow, Delta Cross Channel gate operations, X_2 position, and Delta salinity objectives.

Assumptions Common to All Options

Unless noted, the modeling assumptions for each Option are the same as those applied in the Base study. Several assumptions that differ from the Base study and that were common to all Options and are listed below for clarity:

- Export/Inflow ratio standard was not imposed
- X_2 standards for "A" scenarios were identical to the Base study, but the "B" scenarios were restructured as a function of water year type (dry, moderate, wet).
- QWEST restrictions were not included in the "A" scenarios, but were included in all "B" except for Option 4 where no south Delta diversions would be permitted

- San Joaquin River flow requirements at Vernalis are consistent across options, but differ between the "A" and "B" scenarios

In addition, particle tracking model (PTM) simulations consist of an insertion of 1000 particles spread over 5 days and a simulation period of 45 days. The number of particles that were drawn into the SWP and CVP export pumps, exited into Suisun Bay, exited into agricultural intakes, and those that remained within the Central Delta were counted. The five particle insertion locations included Old River at Quimby Island, Middle River at Mildred Island, San Joaquin River near Big Break, Sacramento River near Cache Slough, San Joaquin River near Head of Old River (see Figure 2-11). Three different simulation periods were identified. In selecting the periods for PTM simulations, the probability of exceedance was computed on the monthly average QWEST flow (San Joaquin River flow at Jersey Point) from the BDCP base DSM2 study. The three months corresponding approximately to the 50%, 70% and 90% probability of exceedance values, as measured in the Base study, were identified as the three simulation periods. These months are September 1977 (50%), March 1990 (70%), and January 1981 (90%).

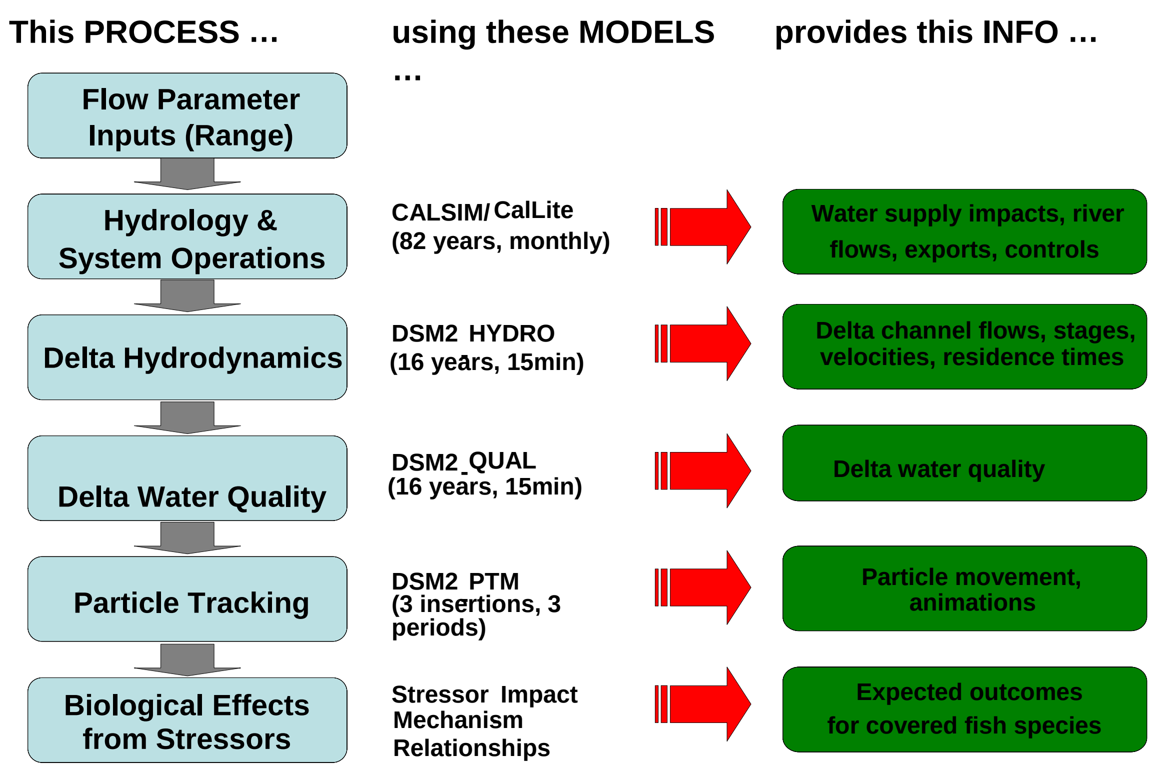

Figure 2-10. Analytical Process and Modeling Approach

The following sections provide brief descriptions of the key additional assumptions included in each of the four Options. For a more detailed description and a comparison of the assumptions refer to Appendix B.

Option 1 Assumptions

Option 1 consists of existing facilities and Delta configuration. Changes from current conditions are due to Delta standards and operational criteria. Under Option 1 (Scenario A), in addition to removal of the D-1641 export-inflow ratio standard, the Fish and Wildlife salinity standard at Collinsville is removed and the Delta Cross Channel gate operations are modified. Those gates are assumed to be closed from February through June and open between July and January.

Under Option 1 (Scenario B), the D-1641 Agricultural water quality objectives completely removed, and higher Rio Vista minimum flow requirements are specified. The Delta Cross Channel gates remain open at all times. The most significant operational criteria change in this scenario is the addition of Old and Middle River and QWEST flow restrictions limiting the magnitude of reverse flows in these channels.

Option 2 Assumptions

Under Option 2, a siphon (with pump facility – see discussion below) would be constructed between Victoria Canal and Clifton Court Forebay to convey Middle River water under Old River. In addition, five new barriers would be constructed. Three of the five barriers at Woodward Cut, Railroad Cut and Connection Slough would prevent interaction between Middle River and Old River through the cuts. The fourth barrier at the Mouth of Old River would prevent or delay fish entrainment into Middle River. The fifth barrier would be constructed in San Joaquin River just downstream of Head of Old River, in lieu of the Head of Old River Barrier. The San Joaquin River Barrier is operated to direct San Joaquin River flow into Old River and provides approximately 400 cfs in downstream flow at all times for downstream consumptive use and water quality needs.

In addition to the new barriers, the operation of the existing temporary agricultural barrier on Middle River was modified. This barrier would prevent ebb flows, permit flood flows over the barrier, and hydraulically isolate Old River from Middle River.

Under Option 2, in addition to the common assumption of removal of the D-1641 export-inflow ratio standard, only the D-1641 Agricultural water quality objectives were included. Contra Costa Water District was assumed to draw water from Middle River in this Option.

In Option 2 Scenario A (the less restrictive scenario) the flow and operational restrictions are the same as those described in Option 1 Scenario A. In Option 2 Scenario B (the more restrictive scenario) no D-1641 water quality objectives are specifically simulated and Rio Vista minimum flow requirements and DCC operations are the same as the Option 1 Scenario B. The most significant operational criteria change in this scenario is the addition of Middle River and QWEST flow restrictions limiting the magnitude of reverse flows in these channels.

Victoria Canal Siphon Capacity

The operation of Option 2 is dependent on the flow capacity of the Victoria Canal siphon. Hydraulic calculations and hydrodynamic model simulations indicate that use of a gravity siphon at this location would limit conveyance to approximately 4,500 cfs (however, see

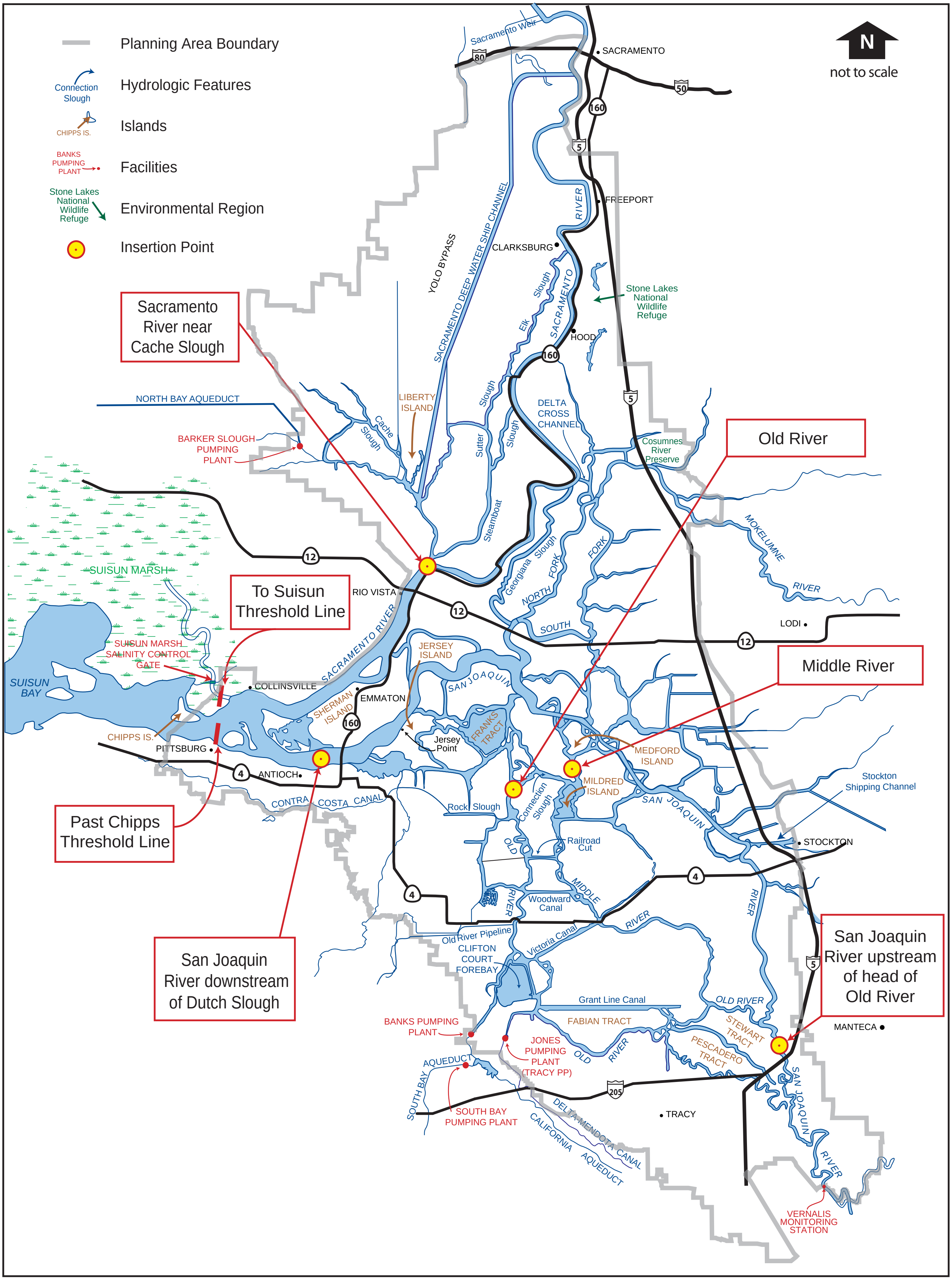

Figure 2-11. DSM2 - Particle Tracking Model Particle Insertion Points

discussion below regarding addition of a pump facility). This section provides detail on the methods used for determining Victoria Canal siphon capacity.

To determine the capacity of the Victoria Canal siphon, a combination of DSM2 model simulations and hydraulic calculations were performed. The siphon was modeled in DSM2 through the use of a gate structure at the southwestern end of Victoria Canal. The gate structure was defined as containing a number of 24′ diameter pipes. The number of pipes was varied during a sensitivity analysis to determine if the flow through the pipes was limited by the driving stage in Victoria Canal or the number of pipes. Results indicate that flows through the siphon are primarily a function of stage in Victoria Canal, and not the number of pipes.

Water flow through a siphon is controlled by the stage difference across the siphon (driving head) and the head losses associated with the siphon. In DSM2, the driving head is provided by tidally-varying stages in Victoria Canal (upstream head), and a user specified elevation on the downstream side of the siphon representative of operable water surface elevations in Clifton Court Forebay. For this study, it was assumed that Clifton Court Forebay could be operated at -1 ft MSL (NGVD 1929). Checks against historic water levels in Clifton Court Forebay indicate that on a daily basis, the minimum stage was below 0 ft MSL more than 80 percent of the time for the past six years, and below -1.0 ft six percent of the time. This indicates the ability of the facility to operate at these levels, but a refined assessment should be conducted if this Option is carried forward.

The head loss across the siphon also influences the siphon capacity. The DSM2 application utilized a broad-crested weir downstream of the siphon to approximate the head loss through the siphon, since DSM2 does not explicitly account for friction losses through pipes. By setting the weir crest elevation at 0 ft and assuming an operable water level in Clifton Court Forebay of -1 ft, a constant head loss of 1 foot is applied to the siphon.

DSM2 predictions of flow through the siphon were used to back calculate the head loss, given the velocity and assumptions for friction and siphon length. Results indicate that the average head loss through a range in tidal flows is 0.8 ft, and thus the assumed 1 ft of loss is conservative, and will result in an underestimation of the potential flow through the siphon.

To determine a more appropriate value for the head loss through the siphon, the standard energy equation was used to solve for velocity, head loss, and flow through the proposed siphon, given water stages from the DSM2 model. Two head loss components were used, the loss at the entrance and the loss along the length of the siphon, assumed to be 2000 feet. The friction coefficient for the pipe was set at 0.015.

Given a time series of upstream stage, taken from the DMS2 model predictions in Victoria Canal with the siphon in place, the velocity and thus flow through the siphon were solved via the energy equation. Flows calculated from the energy equation were averaged on a monthly basis, yielding a long term average of approximately 4,500 cfs through the siphon.

Addition of Pump Facility to the Victoria Canal Siphon

Hydrodynamic modeling outputs indicate that the export capacity under Option 2 is constrained by a gravity siphon connecting Victoria Canal and Clifton Court Forebay (Appendix E). Option 2 in that configuration would not meet water supply objectives (Figure 2-12) because the ability to gravity siphon water is hydraulically constrained to 4,500 cfs. Consequently, the evaluation of Option 2 relative to applicable evaluation criteria was conducted with the addition of a low-head pump at the siphon that would increase the flow capacity from Victoria Canal to Clifton Court Forebay to levels that could meet water supply objectives. Preliminary results of Option 2 with the pump facility indicate that water supply reliability would exceed base conditions under operational Scenario A (Figure 2-13).

The assessment of Option 2 was conducted based on the full model outputs with the gravity siphon interpreted for expected results with a pump facility. Model outputs for Option 2 with the pump facility were not available in time to incorporate into the full evaluation, though, some preliminary outputs of that model run are included as appropriate (e.g., Figure 2-13). Option 2 was evaluated using professional judgment and understanding of Delta hydrodynamics to determine the hydrologic and water quality conditions that would likely result with a pump facility to increase siphon capacity. This professional judgment is based on experience with results of previous CALSIMII and DSM2 studies of numerous operational scenarios conducted by DWR, Reclamation, and state and federal water contractors. Hydrodynamic modeling outputs under Option 2 for the following modeled parameters would be expected to substantively change with addition of a pump facility:

- Volume of water exported
- Delta outflow
- Delta inflow
- Quality of water exported
- Quality of in-Delta water
- Position of X_2
- Hydraulic residence time and Delta flow pattern (from the PTM model)

Numeric values for these parameters under Option 2 with pump facility cannot be determined without running the CALSIMII and DSM2, which could not be accommodated within the Options Evaluation Report schedule. Consequently, the likely performance of Option 2 for these parameters is qualitatively described in Section 4 relative to the model results presented in Appendices D-G for the base condition and each of the Options. The estimated performance of Option 2 relative to the base condition and the other Options for each parameter is described in Table 2-1.

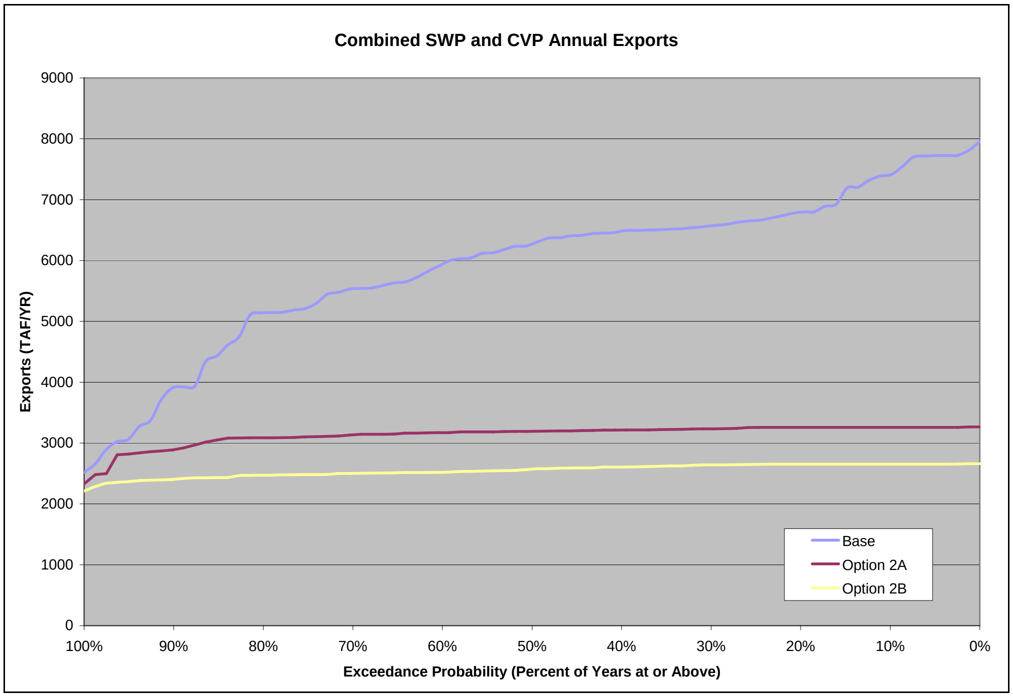

Figure 2-12. Water supply reliability curves for Option 2 without pump facility (gravity siphon, only) under operational scenarios A and B and base conditions

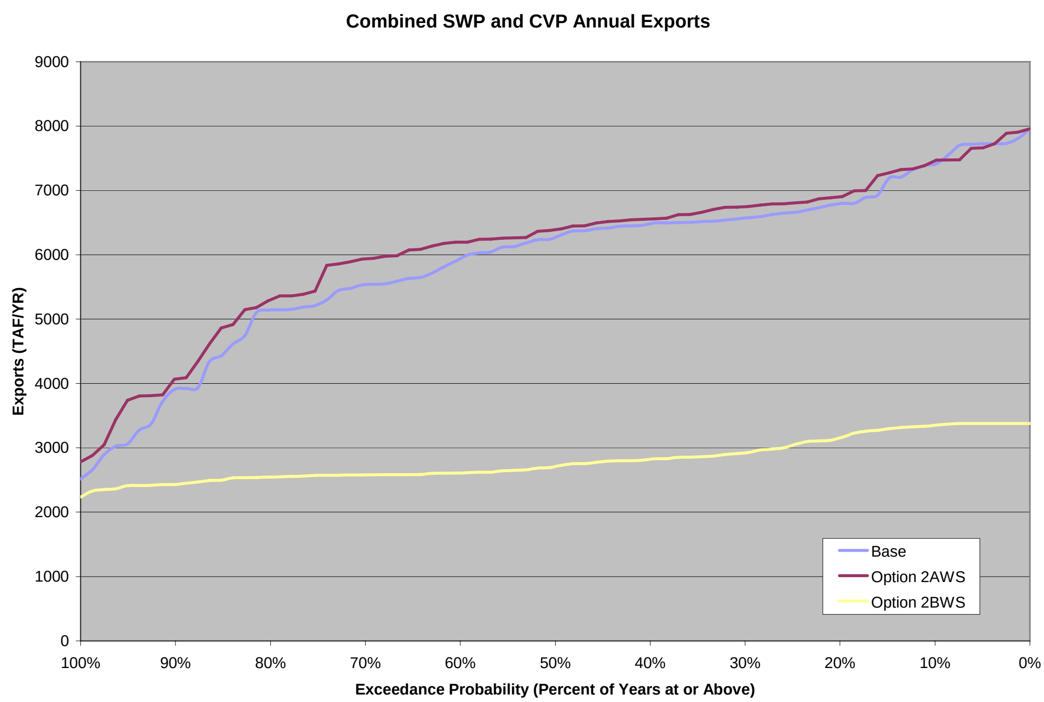

Figure 2-13. Water supply reliability curves for Option 2 with pump facility at the siphon under operational scenarios A and B and base conditions

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Table 2-1. Assumed Performance of Option 2 with a Pump Facility at the Siphon for Important CALSIMII and DSM2 Parameters Relative to the Base Condition and the Options 1-4

	Comparison to Option 2 with Pump Facility[1]				
Model Parameter	**Base Condition**	**Option 1**	**Option 2 without pump facility**	**Option 3**	**Option 4**
Export volume	Less than	Similar to	Greater than	Similar to	Similar to
Delta outflow	Greater than	Similar to	Less than	Similar to	Similar to
Delta inflow	Less than	Similar to	Greater than	Similar to	Similar to
X_2	Less than	Similar to	Greater than	Similar to	Similar to
Export water quality	Greater than	Greater than	Greater than	Less than	Less than
In-Delta water quality	Greater, except for OR	Less than	Less than, higher EC	Uncertain	Uncertain
Particle tracking fate					
Export	Less than	Less than	Greater than	Greater than	Greater than
Downstream	Greater than	Similar to	Greater than	Less than	Uncertain
Central	Greater than	Greater than	Greater than	Uncertain	Uncertain

Notes:
1. "Less than" means Option 2 with pump would have a lower value than the base condition or other Option for that parameter. "Greater than" means Option 2 with pump would have a greater value for that parameter. Determined by best professional judgment based experience with running models under a wide range of input conditions.

Option 3 Assumptions

Option 3 incorporates a dual set of conveyance facilities. The south Delta diversion facility and barrier modifications are as described under Option 2. A second diversion facility is included in this Option for a Sacramento River diversion at Hood or Clarksburg to divert water into a peripheral aqueduct as described in Option 4. Thus, this Option is a hybrid of facilities included in Option 2 and 4. The assumptions specific to the Middle River corridor concept included in Option 2 were carried forward for this option. Similarly, the assumptions specific to the Hood diversion facility included in the Option 4 were carried forward for this option.

In Option 3, the peripheral aqueduct diversion facility was operated preferentially to the south Delta diversion at all times. The Hood diversion was set to a maximum of 15,400 cfs. Under the more restrictive scenario modeled under this option, a maximum diversion of 6,000 cfs was assumed from March to May. Banks Pumping Plant capacity was assumed to operate at a maximum of 8,500 cfs in all months, although the ability to operate continuously at 10,300 cfs should be further evaluated if this option is carried forward. In both scenarios, it was assumed that the Contra Costa Water District intake would be relocated to draw water directly from the peripheral aqueduct.

Rio Vista minimum flow requirements during January through June were increased significantly over the Base condition, Option 1, or Option 2 to reflect the primary downstream control on the peripheral aqueduct diversion. Under both scenarios of this Option, the Delta Cross Channel gates are closed year-round.

Option 4 Assumptions

Under Option 4, the peripheral aqueduct diversion described above for Option 3 is included as a replacement for the current south Delta diversions of the SWP and CVP. Because there is no direct diversion from the south Delta, the VAMP export, Middle River flow, and QWEST flow restrictions are assumed not to be applicable. As in Option 3, Rio Vista minimum flow requirements were increased significantly over the Base, Option 1, and Option 2 and reflect the primary control on the Isolated Facility diversion. Several levels of Rio Vista minimum flow standards in Dry and Critical years were modeled to reduce the impact on upstream storage conditions.

2.3 EVALUATION OF THE BIOLOGICAL CRITERIA

This section describes the overall approach to conducting the evaluation of the Options in relation to the biological criteria and includes descriptions of the metrics, tools, scales and important assumptions used to conduct the evaluation in relation to each of the covered fish species. Metrics are defined as specific standards against which the performance of each Option is evaluated. Tools are defined as the methods and information used to evaluate performance of each Option in relation to the metric. Scales are the quantitative or qualitative measures used to express the performance of each Option relative to the tools.

The process used to conduct the evaluation of each criterion for each of the covered species is described below:

- identification of the stressors for each covered species (from Appendix C) that could be affected by the conveyance configuration and habitat restoration opportunities for each Option;

- development of metrics that address the likely effects (positive or negative) of each Option on the impact mechanisms for each of the identified stressors and identify the tools for measuring those effects;

- use of the metric tools to evaluate the likely performance of each Option for each covered fish species relative to each metric. Tools are based on CALSIM II and DSM2 modeling results, published results of species studies and other credible sources of relevant information, and professional judgment; and

- summarization of the relative performance of each Option for each species relative to the biological criteria, based on the scaled metrics.

The metrics, tools, and scales for the biological criteria are presented in Table 2-2.

Table 2-2. Metrics, Tools, and Scales for Biological Criteria

Metric	Relationship	Tools	Scale
Criterion #1. Relative degree to which the Option would reduce species mortality attributable to non-natural mortality sources, in order to enhance production (reproduction, growth, survival), abundance, and distribution for each of the covered fish species (BDCP Conservation Objective)			
B1. Opportunity for restoration of aquatic and intertidal habitat under the Option	Improving the quality and extent of aquatic and intertidal habitat in the Delta is hypothesized to reduce mortality by: • Improving the abundance and availability of food that is more nutritious than non-native species; • Create conditions that are less favorable for supporting non-native species that compete for food; and • Create conditions that are less favorable to non-native predators and that reduce the susceptibility of covered fish species to predation. **Certainty:** 2	A. Proportion of the planning area available for restoration of high-function aquatic and intertidal habitats	**Proportion of the Delta (%)** 5 = 80 to 100% 4 = 51% to 79% 3 = 31% to 50% 2 = 11% to 30% 1 = 0 to 10%
B2. Opportunity for improving inflows into the Delta	Changes in peak total Delta inflows during peak runoff periods change the frequency and duration of floodplain inundation and affect: • Inputs of nutrients to the Delta, which affects food production and availability, • Turbidity, which affects the foraging efficiency and predation vulnerability of delta and longfin smelt, • Extent of food available for Sacramento splittail rearing. **Certainty:** 3	A. Change from base conditions in hydrologic modeling results for peak total Delta inflows during January-March	**Change (%)** 5 = > +5% 4 = +1% to +4% 3 = 0 to -4% 2 = -5% to -9% 1 = < -10%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
	The potential range of spring Delta inflow is indicative of the ability of the Option to dilute contaminants that could result in mortality **Certainty:** 3	B. Change from base conditions in hydrologic modeling results for Sacramento River flows at Rio Vista during March and April	**Change (%)** 5 = > +10% 4 = +10% to -9% 3 = -10% to -19% 2 = -20% to -29% 1 = < -30%
	The potential range of spring Delta inflow is indicative of the ability of the Option to dilute contaminants that could result in mortality **Certainty:** 3	C. Change from base conditions in hydrologic modeling results for total Delta inflow during March and April	**Change (%)** 5 = > +10% 4 = +10% to -9% 3 = -10% to -19% 2 = -20% to -29% 1 = < -30%
B3. Opportunities to improve hydraulic residence time	Changes in hydraulic residence time within the central Delta affect food production and turbidity which affects the foraging efficiency and vulnerability to predation of all species but splittail (splittail are addressed separately below). The particle tracking model approximates the likelihood of nutrients and food remaining in the central Delta **Certainty:** 3	A. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with "central" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
		B. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with "central" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
	Changes in hydraulic residence time within the central Delta affect food production and turbidity which affects the foraging efficiency and vulnerability to predation of splittail. The particle tracking model approximates the likelihood of nutrients and food remaining in the central Delta under drier conditions, when food is limiting to splittail **Certainty:** 4	A. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with "central" fate for the 50% exceedance hydrology	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
		B. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with "central" fate for the 50% exceedance hydrology	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
B4. Ability to reduce the export of nutrients and food from the Delta	The SWP/CVP export facilities and agricultural diversions entrain food and nutrients from the Delta that can affect food production and availability to all fish species but splittail. The particle tracking model approximates the likelihood for entrainment of nutrients and food of these diversions. **Certainty:** 3	A. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with either "SWP/CVP exports" or "agricultural diversions" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = < -75% 4 = -51% to -75% 3 = -26% to -50% 2 = 0% to -25% 1 = > 0%
		B. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with either "SWP/CVP exports" or "agricultural diversions" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = < -75% 4 = -51% to -75% 3 = -26% to -50% 2 = 0% to -25% 1 = > 0%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
	The SWP/CVP export facilities and agricultural diversions entrain food and nutrients from the Delta that can affect food production and availability to splittail. The particle tracking model approximates the likelihood for entrainment of nutrients and food of these diversions under drier conditions, when food is limiting to splittail. **Certainty:** 4	C. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with either "SWP/CVP exports" or "agricultural diversions" fate for the 50% exceedance hydrological condition	**Change (%)** 5 = < -75% 4 = -51% to -75% 3 = -26% to -50% 2 = 0% to -25% 1 = > 0%
		D. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with either "SWP/CVP exports" or "agricultural diversions" fate for the 50% exceedance hydrological condition	Change (%) 5 = < -75% 4 = -51% to -75% 3 = -26% to -50% 2 = 0% to -25% 1 = > 0%
B5. Ability to reduce entrainment at the SWP/CVP export facilities	Entrainment of particles using the particle tracking model approximate the likelihood for entrainment of larval delta smelt and longfin smelt at the SWP/CVP facilities **Certainty:** 2	B. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days for with "CVP/SWP exports" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = < -75% 4 = -51% to -75% 3 = -26% to -50% 2 = 0% to -25% 1 = > 0%
		C. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with "CVP/SWP exports" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	Change (%) 5 = < -75% 4 = -51% to -75% 3 = -26% to -50% 2 = 0% to -25% 1 = > 0%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
	There is evidence that the degree of reverse flow in Old and Middle Rivers is positively correlated to entrainment levels of juvenile and adult fish **Certainty:** 3	D. Change from base conditions in Old and Middle River reverse flows in modeling results during January	**Change (cfs)** 5 = > 0 4 = 0 to -1999 3 = -2000 to -3999 2 = -4000 to -5999 1 = < -6000
		E. Change from base conditions in Old and Middle River reverse flows in modeling results during April	**Change (cfs)** 5 = > 0 4 = 0 to -1999 3 = -2000 to -3999 2 = -4000 to -5999 1 = < -6000
Criterion #2. Relative degree to which the Option would provide water quality and flow conditions necessary to enhance production (reproduction, growth, survival) , abundance, and distribution for each of the covered fish species (BDCP Conservation Objective)			
B6. Ability to improve the location of the low salinity zone during sensitive periods	The location of X_2 during April is related to the production, growth, and survival of delta smelt and longfin smelt **Certainty:** 3	A. Change in modeling results for the location of X_2 during April from base conditions	**<u>Change (km)</u>** 5 = < -6 4 = -5.9 to -3 3 = -2.9 to 0 2 = 0.1 to +2.9 1 = >3
B7. Ability to improve turbidity of Delta waters	Changes in turbidity of Delta waters affects foraging efficiency and predation vulnerability of delta and longfin smelt. The particle tracking model approximates the likelihood for entrainment of algae and other particles	A. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with "central" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
	that contribute to turbidity at the SWP/CVP facilities. **Certainty:** 3	B. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with "central" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
	Changes in peak total Delta inflows during peak runoff periods affects sediment inputs that govern turbidity in Delta waters which affects the foraging efficiency and vulnerability to predation. **Certainty:** 3	C. Change from base conditions in hydrologic modeling results for peak total Delta inflows during January-March	<u>**Change (%)**</u> 5 = > +5% 4 = +1% to +4% 3 = 0 to -4% 2 = -5% to -9% 1 = < -10%
	Reduction in abundance of non-native species like filter-feeding clams (*Corbula, Corbicula*) and aquatic vegetation (*Egeria*, water hyacinth) could result in an increase in turbidity, **Certainty:** 2	D. Proportion of the planning area available for restoration of high-function aquatic and intertidal habitats	<u>**Proportion of the Delta (%)**</u> 5 = 80 to 100% 4 = 51% to 79% 3 = 31% to 50% 2 = 11% to 30% 1 = 0 to 10%
B8. Ability to improve net downstream flow	Changes in net downstream flow affects downstream transport of larval and juvenile fish. The particle tracking model approximates downstream transport of larvae and young juveniles from all Covered Species of fish except green and white sturgeon. **Certainty:** 2	A. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with either "past Chipps Island" or "to Suisun Marsh" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
		B. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with either "past Chipps Island" or "to Suisun Marsh" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
	Changes in spring Sacramento River flow at Rio Vista affects downstream transport of larval and juvenile fish and upstream migration cues for adult salmonids. **Certainty:** 2	C. Change from base conditions in hydrologic modeling results for Sacramento River flows at Rio Vista during March and April	**Change (%)** 5 = > +10% 4 = +10% to -9% 3 = -10% to -19% 2 = -20% to -29% 1 = < -30%
	Changes in spring total Delta outflow affects downstream transport of larval and juvenile fish and upstream migration cues for adult salmonids. **Certainty:** 3	D. Change from base conditions in hydrologic modeling results for total Delta outflow during March and April	**Change (%)** 5 = > +10% 4 = +10% to -9% 3 = -10% to -19% 2 = -20% to -29% 1 = < -30%
B9. Ability to provide cool water flows in the Sacramento, American, and Feather Rivers	The temperatures of water released from Shasta, Oroville, and Folsom Reservoirs may vary under the Options and, therefore, have differing effects on Sacramento River salmonids and sturgeon **Certainty:** 3	A. Change from base conditions in hydrologic modeling results for Shasta Reservoir storage volume	**Change (%)** 5 = > +10% 4 = +6% to +10% 3 = -5% to +5% 2 = -6% to -10% 1 = < -10%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
		B. Change from base conditions in hydrologic modeling results for Oroville Reservoir storage volume	**Storage (maf)** 5 = > 1.5 4 = 1.49 to 1.4 3 = 1.39 to 1.3 2 = 1.29 to 1.2 1 = < 1.2
		C. Change from base conditions in hydrologic modeling results for Folsom Reservoir storage volume	**Storage (maf)** 5 = > 0.4 4 = 0.39 to 0.35 3 = 0.34 to 0.3 2 = 0.29 to 0.25 1 = < 0.25
Criterion #3. Relative degree to which the Option would increase habitat quality, quantity, accessibility, and diversity in order to enhance and sustain production (reproduction, growth, survival), abundance, and distribution; and to improve the resiliency of each of the covered species' populations to environmental change and variable hydrology (BDCP Conservation Objective).			
B10. Opportunity for restoration of aquatic and intertidal habitat under the Option	Improving the quality and extent of aquatic and intertidal habitat in the Delta for covered species will increase the production, abundance, and distribution of covered species. **Certainty:** 2	A. Proportion of the planning area available for restoration of high-function aquatic and intertidal habitats	**Proportion of the Delta (%)** 5 = 80 to 100% 4 = 51% to 79% 3 = 31% to 50% 2 = 11% to 30% 1 = 0 to 10%
B11. Improve accessibility to spawning and rearing habitat	Changes in peak total Delta inflows during peak runoff periods change the frequency and duration of floodplain inundation that provides splittail spawning and larval rearing habitat. **Certainty:** 4	B. Change from base conditions in modeling results for peak total Delta inflows during January-March	**Change (%)** 1 = > +5% 2 = +1% to +4% 3 = 0 to -4% 4 = -5% to -9% 5 = < -10%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
	The location of X_2 during April determines the extent of rearing habitat available for delta and longfin smelt **Certainty:** 3	A. Change from base conditions in modeling results for the location of X_2 during April	**Change (km)** 1 = < -6 2 = -5.9 to -3 3 = -2.9 to 0 4 = 0.1 to +2.9 5 = >3
B12. Ability to improve turbidity of Delta waters	Changes in turbidity of Delta waters affects foraging efficiency and predation vulnerability of delta and longfin smelt. The particle tracking model approximates the likelihood for entrainment of algae and other particles that contribute to turbidity at the SWP/CVP facilities. **Certainty:** 3	A. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with "central" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
		B. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with "central" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
	Changes in peak total Delta inflows during peak runoff periods affects sediment inputs that govern turbidity in Delta waters which affects the foraging efficiency and vulnerability to predation. **Certainty:** 3	C. Change from base conditions in hydrologic modeling results for peak total Delta inflows during January-March	**Change (%)** 5 = > +5% 4 = +1% to +4% 3 = 0 to -4% 2 = -5% to -9% 1 = < -10%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
	Reduction in abundance of non-native species like filter-feeding clams (*Corbula, Corbicula*) and aquatic vegetation (*Egeria*, water hyacinth) could result in an increase in turbidity, **Certainty:** 2	D. Proportion of the planning area available for restoration of high-function aquatic and intertidal habitats	**Proportion of the Delta (%)** 5 = 80 to 100% 4 = 51% to 79% 3 = 31% to 50% 2 = 11% to 30% 1 = 0 to 10%
B13. Ability to improve net downstream flow	Changes in net downstream flow affects downstream transport of larval and juvenile fish to rearing habitat. The particle tracking model approximates downstream transport of larvae and young juveniles from all Covered Species of fish except green and white sturgeon. **Certainty:** 2	A. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with either "past Chipps Island" or "to Suisun Marsh" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
		B. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with either "past Chipps Island" or "to Suisun Marsh" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
	Changes in spring Sacramento River flow affects downstream transport of larval and juvenile delta smelt, longfin smelt and splittail to rearing habitat. **Certainty:** 3	E. Change from base conditions in hydrologic modeling results for Sacramento River flows at Rio Vista during March and April	**Change (%)** 5 = > +9% 4 = +10% to -9% 3 = -10% to -19% 2 = -20% to -29% 1 = >-30%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
	Changes in total spring Delta outflow affects downstream transport of larval and juvenile delta and longfin smelt to rearing habitat. **Certainty:** 3	D. Change from base conditions in hydrologic modeling results for total Delta outflow during March and April	<u>**Change (%)**</u> 5 = > +9% 4 = +10% to -9% 3 = -10% to -19% 2 = -20% to -29% 1 = < -30%
Criterion #4. Relative degree to which the Option would increase food quality, quantity, and accessibility (e.g., phytoplankton, zooplankton, macro-invertebrates, forage fish) to enhance production (reproduction, growth, survival) and abundance for each of the covered fish species (BDCP Conservation Objective).			
B14. Opportunities for restoration of aquatic and intertidal habitat	Improving the quality and extent of aquatic and intertidal habitat in the Delta is hypothesized to reduce mortality by: • Improving the abundance and availability of native prey species that are more nutritious than non-native species; and • Create conditions that are less favorable for supporting non-native species that compete for food. • **Certainty:** 2	A. Proportion of the planning area available for restoration of high-function aquatic and intertidal habitats	<u>**Proportion of the Delta (%)**</u> 5 = 80 to 100% 4 = 51% to 79% 3 = 31% to 50% 2 = 11% to 30% 1 = 0 to 10%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
B15. Opportunities for improving peak inflows into the Delta	Changes in peak total Delta inflows during peak runoff periods change the frequency and period of floodplain inundation affect: • Inputs of nutrients to the Delta, which affects food production and availability, • Turbidity, which affects the foraging efficiency and predation vulnerability of delta and longfin smelt, • Extent of food available for Sacramento splittail rearing. **Certainty:** 3	A. Change from base conditions in modeling results for peak total Delta inflows during January-March	**Change (%)** 5 = > +5% 4 = +1% to +4% 3 = 0 to -4% 2 = -5% to -9% 1 = < -10%
B16. Opportunities to improve hydraulic residence time	Changes in hydraulic residence time within the central Delta affect food production and turbidity which affects the foraging efficiency to all fish species but splittail (splittail are addressed separately below). The particle tracking model approximates the likelihood for particles remaining in the central Delta. **Certainty:** 3	A. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with "central" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
		B. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with "central" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
	Changes in hydraulic residence time within the central Delta affect food production and turbidity which affects the foraging efficiency to all fish species but splittail. The particle tracking model approximates the likelihood for particles remaining in the central Delta under drier conditions, when food is limiting to splittail **Certainty:** 4	C. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with "central" fate for the 50% exceedance hydrological condition	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
		D. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with "central" fate for the 50% exceedance hydrological condition	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
B17. Ability to reduce the export of nutrients and food from the Delta	The SWP/CVP export facilities and agricultural diversions entrain food and nutrients from the Delta that can affect food production and availability to all fish species but splittail. The particle tracking model approximates the likelihood for entrainment of nutrients and food of these diversions. **Certainty:** 3	A. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with either "SWP/CVP exports" or "agricultural diversions" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	Change (%) 5 = < -75% 4 = -51% to -75% 3 = -26% to -50% 2 = 0% to -25% 1 = > 0%
		B. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with either "SWP/CVP exports" or "agricultural diversions" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	Change (%) 5 = < -75% 4 = -51% to -75% 3 = -26% to -50% 2 = 0% to -25% 1 = > 0%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
	The SWP/CVP export facilities and agricultural diversions entrain food and nutrients from the Delta that can affect food production and availability to splittail. The particle tracking model approximates the likelihood for entrainment of nutrients and food of these diversions under drier conditions, when food is limiting to splittail. **Certainty:** 4	C. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with either "SWP/CVP exports" or "agricultural diversions" fate for the 50% exceedance hydrological condition	Change (%) 5 = < -75% 4 = -51% to -75% 3 = -26% to -50% 2 = 0% to -25% 1 = > 0%
		D. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with either "SWP/CVP exports" or "agricultural diversions" fate for the 50% exceedance hydrological condition	Change (%) 5 = < -75% 4 = -51% to -75% 3 = -26% to -50% 2 = 0% to -25% 1 = > 0%
Criterion #5. Relative degree to which the Option would reduce the abundance of non-native competitors and predators to increase native species production (reproduction, growth, survival), abundance and distribution for each of the covered fish species (BDCP Conservation Objective).			
B18. Opportunity for restoration of aquatic and intertidal habitat under the Option	Improving the quality and extent of aquatic and intertidal habitat in the Delta is hypothesized to: • Create conditions that are less favorable for supporting non-native species that compete for food; and • Create conditions that are less favorable to non-native predators and that reduce the vulnerability of covered fish species to predation. **Certainty:** 2	A. Proportion of the planning area available for restoration of high-function aquatic and intertidal habitats	**Proportion of the Delta (%)** 5 = 80 to 100% 4 = 51% to 79% 3 = 31% to 50% 2 = 11% to 30% 1 = 0 to 10%

Table 2-2. Metrics, Tools, and Scales for Biological Criteria (continued)

Metric	Relationship	Tools	Scale
Criterion #6. Relative degree to which the Option improves ecosystem processes in the BDCP planning area to support aquatic and associated habitats (BDCP Conservation Objective).			
B19. Opportunities for restoration of aquatic and intertidal habitat under the Option	Improving the quality and extent of aquatic and intertidal habitat in the Delta is hypothesized to contribute to higher levels of ecosystem function **Certainty:** 2	A. Proportion of the planning area available for restoration of high-function aquatic and intertidal habitats	**Proportion of the Delta (%)** 5 = 80 to 100% 4 = 51% to 79% 3 = 31% to 50% 2 = 11% to 30% 1 = 0 to 10%
B20. Opportunity to improve hydraulic residence time	Changes in hydraulic residence time within the central Delta affect food production and turbidity, which should contribute to higher levels of ecosystem function to all fish species but splittail (splittail are addressed separately below). The particle tracking model approximates the likelihood for particles remaining in the central Delta. **Certainty:** 3	A. Change from base conditions in particle tracking modeling results for percentage of particles after 14 days with "central" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
		B. Change from base conditions in particle tracking modeling results for percentage of particles after 28 days with "central" fate for the three hydrology conditions (50%, 70%, and 90% exceedance)	**Change (%)** 5 = > 75% 4 = 51% to 75% 3 = 26% to 50% 2 = 0% to 25% 1 = < 0%
Criterion #7. Relative degree to which the Option can be implemented within a timeframe to meet the near-term needs of each covered fish species (post BDCP authorization).			
B21. Likelihood that the Option can be implemented before populations decline sufficiently to inhibit the likelihood for their future recovery	The longer the period required for implementation of the Option the less likely the Option will meet the near-term needs of covered fish species **Certainty:** Definitions not applicable.	Estimated time post-BDCP approval required to complete planning, design, and construction phases of Option implementation infrastructure	**Estimated Time to Completion** 5 = 0-5 years 4 = 6-10 years 3 = 11-15 years 2 = 16-20 years 1 = > 20 years

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Important assumptions used to conduct the analysis for biological criteria are presented in Table 2-3.

Table 2-3. Important Assumptions used to Evaluate the Biological Criteria

Criterion #1. **Relative degree to which the Option would reduce species mortality attributable to non-natural mortality sources, in order to enhance production (reproduction, growth, survival), abundance, and distribution for each of the covered fish species (BDCP Conservation Objective).**
1. When combined reverse flows in Old and Middle rivers exceeded -5000 cfs in January and February of 1993-2006, salvage of delta smelt increased dramatically (Smith et al. 2006). This assessment assumes that the risk of entrainment for larval, juvenile, sub-adult, and adult delta smelt would increase as reverse flows in Old and Middle rivers increase. Although delta smelt are vulnerable to entrainment at the export facilities at various times during the year, the analysis of hydrologic conditions was simplified by analyzing results for only January (pre-spawning delta smelt) and April (larval and early juvenile delta smelt). As part of Options 3 and 4 water diversions would be made from the Sacramento River at a location in the vicinity of Hood. The diversion would be equipped with a positive barrier fish screen, designed and operated in accordance with current criteria, has been assumed to be 95% effective in avoiding entrainment losses of all but the smallest fish eggs and larvae.
2. Adverse effects of legal and illegal harvest on covered fish species would not be affected with implementation of any of the Options. Consequently, these stressors are described as contributing to the reduction in covered fish species production, distribution, and abundance, but are not evaluated under this criterion.
3. The CALSIMII modeling results indicate that major CVP and SWP reservoirs could be drawn down to levels that could adversely affect the temperature of water released from reservoirs, which could have an adverse effect on salmonids and sturgeon in upstream of Delta habitats. In actuality, releases from these reservoirs would only be operated to provide for cold water releases to maintain conditions for these species as mandated under permit conditions. Although not reflected in the hydrologic modeling results for the various Options, under actual operating conditions modifications to reservoir releases and/or exports would be modified to the extent possible to avoid or minimize depletion of the cold water pool. Consequently, the evaluation assumes that the Options would have no adverse effects related to changes in upstream water temperatures on salmonids and sturgeon.
4. Although risk for entrainment at the CVP/SWP export facilities for sturgeon would be reduced under some of the Options and not increased under any of the Options, it is not considered to be an important stressor for sturgeon and, therefore, effects of the Options on sturgeon entrainment risk are not evaluated under this criterion.
5. Predation on sturgeon within the planning area is not considered to be an important stressor on sturgeon, although predation on larval and small juvenile sturgeon in spawning and rearing habitats upstream of the planning area is considered to be an important stressor. Because the Options would not affect sturgeon predation risk outside of the planning area, this stressor is not evaluated under the biological criteria.

Table 2-3. Important Assumptions used to Evaluate the Biological Criteria (continued)

Criterion #2.	Relative degree to which the Option would provide water quality and flow conditions necessary to enhance production (reproduction, growth, survival), abundance, and distribution for each of the covered fish species (BDCP Conservation Objective).

1. For purposes of this assessment it was assumed that the transport of larval delta smelt, nutrients, phytoplankton, zooplankton, and other planktonic organisms can be modeled using the PTM. This model provides a useful tool for determining the percentage of larval fish and their potential food supplies that would move downstream towards Chipps Island and Suisun Bay.
2. Changes in the configuration of the Delta channels under Option 2 and 3 would include a series of operable barriers to isolate the Old River area and central Delta from the hydraulic influence of the SWP and CVP exports, and construction of a gravity or pumped siphon to convey water from Middle River to the export facilities while allowing the flow from the San Joaquin River to pass downstream into the central Delta. Under these conditions, residence time within the central Delta would be increased, flushing would be reduced, and nutrient loading may stimulate phytoplankton blooms. Under severe conditions large phytoplankton blooms could result in a diel depletion of dissolved oxygen concentrations within the central Delta. These diel depressions in dissolved oxygen could adversely impact habitat conditions for resident and migratory fish and other aquatic resources. For purposes of this analysis it has been assumed that if monitoring showed evidence of a potentially severe depression in dissolved oxygen, the operable gates on the barriers would be opened to increase flushing and maintain suitable dissolved oxygen levels in the central Delta to support fish. Therefore, no adverse impacts would be expected from dissolved oxygen depressions within the Delta.
3. Water quality within the Delta is influenced by point and non-point source discharges of pollutants and toxics. The watershed tributary to the Delta supports extensive agricultural, municipal, and industrial uses. The Delta also supports extensive agriculture and urban populations. Pesticides, herbicides, salts, and other chemicals enter the Delta from these sources and potentially affect covered species directly (chronic or acute exposure resulting in reduced health, growth, reproduction, survival) or indirectly through changes in food supplies. For purposes of these analyses, it has been assumed that the most efficient method for reducing exposure to toxics is through source control and enforcement that would apply equally across all Options. Operations under the various Options included in this analysis have the potential to also affect dilution flows, primarily from the Sacramento River, that would be expected to change the concentrations of toxics within the Delta.
4. Reduced turbidity is an important stressor for sturgeon that can increase predation risk for larval and small juvenile sturgeon in spawning and rearing habitats upstream of the planning area and is not an important stressor within the planning area. Consequently, this stressor is not evaluated under the biological criteria for sturgeon.
5. Concern has been expressed that allowing San Joaquin River water, which has a high selenium load, to discharge into the Delta under Options 2, 3, and 4 could increase the bioaccumulation of selenium in sturgeon and splittail. This evaluation assumes that, because source control reductions in selenium San Joaquin River selenium loads have been mandated the Regional Water Quality Board to be in place by 2012, selenium concentrations would not become elevated from base conditions under Options 2, 3, and 4 and, therefore, would not increase the risk for bioaccumulation of selenium in sturgeon and splittail beyond existing conditions. However, if source controls were to be unsuccessful such that selenium concentrations were to increase in the Delta, these Options would be expected to have an overall adverse effect on sturgeon and splittail.

Table 2-3. Important Assumptions used to Evaluate the Biological Criteria (continued)

6. Water passing downstream from the upper Sacramento River is typically in thermal equilibrium with atmospheric conditions by the time it enters the northern Delta. As a result, seasonal water temperatures within the Delta are expected to be the same under all options evaluated.
Criterion #3. Relative degree to which the Option would increase habitat quality, quantity, accessibility, and diversity in order to enhance and sustain production (reproduction, growth, survival), abundance, and distribution; and to improve the resiliency of each of the covered species' populations to environmental change and variable hydrology (BDCP Conservation Objective).
1. The BDCP has not yet determined the extent of habitat that would need to be restored or enhanced to achieve BDCP planning objectives; therefore, the evaluation of this criterion assumes that there would be an equal amount of intertidal and subtidal aquatic habitat restored and enhanced under each of the Options. The geographic area that is considered highly suitable for restoration and enhancement of habitat, however, differs among the Options (see Figures 1-2 to 1-5). Consequently, the evaluation of this criterion focuses on identifying the varying degrees of benefits that could be afforded to each of the covered species based on the opportunities presented under each of the Options for restoring physical habitat in different locations within the Delta. 2. Though there is considerable uncertainty regarding spawning habitat requirements, this assessment assumes that spawning habitat for species such as delta smelt can be successfully restored under each of the Options. 3. Upstream dams and weirs are an impact mechanism for preventing access of salmonids and sturgeon to historical spawning habitats. Physical features that may serve as barriers to upstream movement to spawning habitats within the planning area can be addressed be addressed equally under the Options and, therefore, the effects of the Options on this stressor are not addressed further in this evaluation.
Criterion #4. Relative degree to which the Option would increase food quality, quantity, and accessibility (e.g., phytoplankton, zooplankton, macro-invertebrates, forage fish) to enhance production (reproduction, growth, survival) and abundance for each of the covered fish species (BDCP Conservation Objective).
1. The evaluation of this criterion assumes that restoration of aquatic subtidal and intertidal habitats under the Options would improve habitat conditions for the covered fish species and reduce habitat conditions for some non-native competitors such that adverse effects of non-native competitors on food availability would be reduced from base conditions (Matern et al. 2002, Lund et al. 2007b) 2. The evaluation of this criterion assumes that restoration of shallow water subtidal and intertidal habitats under the Options would improve habitat conditions for native zooplankton and thus increase food quality for species such as delta smelt, longfin smelt, and other fish species (POD Action Plan 2007) 3. The evaluation of this criterion assumes that results of the PTM modeling for the fate of particles that are removed from the Delta by the SWP/CVP export facilities and in-Delta diversions are an indicator of the potential for the Options to remove nutrients, organic material, phytoplankton, and zooplankton from the Delta aquatic system, thus affecting food production and availability.

Table 2-3. Important Assumptions used to Evaluate the Biological Criteria (continued)

Criterion #5.	**Relative degree to which the Option would reduce the abundance of non-native competitors and predators to increase native species production (reproduction, growth, survival), abundance and distribution for each of the covered fish species (BDCP Conservation Objective).**
1. The evaluation of this criterion assumes that restoration of aquatic subtidal and intertidal habitats under the Options would improve habitat conditions for the covered fish species such that their vulnerability to predation would be reduced and reduce habitat conditions for some non-native competitors such that adverse effects of non-native predators/competitors would be reduced from base conditions (Matern et al. 2002, Lund et al. 2007b). The response of predatory species to restored habitats, however, is uncertain and therefore the degree to which habitat restoration under each of the Options would reduce vulnerability to predation is uncertain. For example, the central Delta currently supports a population of largemouth bass and increasing intertidal and subtidal habitats could contribute to a further increase in the abundance of these non-native predators, which may or may not outweigh the benefits of reducing predation vulnerability provided by habitat restoration. 2. This evaluation assumes that restoration of habitat could be implemented such that production of nutrients and native zooplankton could be improved and thereby improve food availability and quality for delta smelt, longfin smelt, juvenile salmon, and other covered fish species. The response of these fish and the species they rely on as a food supply is dynamic and complex. There is a relatively high degree of uncertainty in predicting the effectiveness of many of the actions in reducing the adverse effects of non-native species on delta smelt and other covered fish species.	
Criterion #6.	**Relative degree to which the Option improves ecosystem processes in the BDCP planning area to support aquatic and associated habitats (BDCP Conservation Objective).**
1. The degree that an Option would contribute to improvements in ecosystem processes would depend on two primary factors: (1) opportunities to enhance or restore subtidal and intertidal aquatic habitat over a wide geographic area within the Delta, and (2) degree that changes in the conveyance facilities and their operations restore natural hydrologic flow patterns within Delta channels. For example, hydrologic flow patterns under base conditions include reverse flows in channels such as Old and Middle rivers and the lower San Joaquin River, as well as high flows and water velocities within Delta channels currently used to convey water from the Sacramento River across the Delta to the south Delta export facilities. Restoring flow patterns to reflect a net westerly flow, reductions in channel velocities and increased hydraulic residence times, and avoid reverse flows are all expected to contribute positively to improvements in ecosystem processes.	
Criterion #7.	**Relative degree to which the Option can be implemented within a timeframe to meet the near-term needs of each covered fish species (post BDCP authorization).**
1. Because the extent of habitat that would be restored among the Options has not yet been determined, the time required to implement habitat restorations and enhancements (e.g., securing lands for restoration and enhancement, planning, NEPA/CEQA and other regulatory compliance, design, construction) is assumed to be the same among the Options and, therefore, are not addressed in the evaluation of this criterion.	

2.4 EVALUATION OF THE PLANNING CRITERIA, FLEXIBILITY/ DURABILITY/SUSTAINABILITY, AND OTHER RESOURCE IMPACTS CRITERIA

This section includes descriptions of the metrics, tools, and scales used to conduct the evaluation of planning, flexibility/sustainability/durability, and other resource impacts criteria. Metrics are the specific standards against which the performance of each Option is evaluated. Tools are the methods and information used to evaluate performance of each Option in relation to the metric. Scales are the quantitative or qualitative measures used to express the performance of each Option relative to the tools.

The process used to conduct the evaluation of each criterion included:

- development of metrics that address each criterion and identification of the tools and scales for measuring the performance of each Option for each metric;
- use of the tools to evaluate the likely relative performance of each Option for each metric, based on the best available information and professional judgment
- summarization of the relative performance of each Option for each criterion based on the scaled metrics.

The metrics, tools, and scales for the planning criteria, flexibility/sustainability/durability, and other resource impacts are presented in Tables 2-4, 2-5, and 2-6, respectively.

Table 2-4. Metrics, Tools, and Scales for Evaluation of Planning Criteria

Metric	Tools	Scale
Criterion #8: Relative degree to which the Option allows covered activities to be implemented in a way that meets the goals and purposes of those activities		
P1. Water supply reliability	Change in annual combined CVP/SWP exports at 50% exceedance probability from the base condition	**High** = >+5% **Moderate** = <+5% to >-5% **Low** = <-5% to >-10% **Very Low** = <-10%
P2. Operational flexibility	Number of pathways available for exporting water from the Delta and qualitative assessment of the potential for regulatory constraints to exporting water	**High** = more than one pathway and reduction in regulatory constraints **Moderate** = one pathway and substantial reduction in regulatory constraints **Low** = more than one pathway and limited or no reduction in regulatory constraints **Very Low** = one pathway and limited or no reduction in regulatory constraints
P3. Quality of water exported from the SWP/CVP facilities	Hydrologic modeling results for exported water quality expressed as mean annual EC	**High** = EC <200 umhos/cm **Moderate** = EC 200 to 300 umhos/cm **Low** = EC 300 to 400 umhos/cm **Very Low** = EC >400 umhos/cm
Criterion #9: The relative feasibility and practicability of the Option, including the ability to fund, engineer, and implement		
P4. Relative feasibility and practicability to address habitat conservation and water supply goals	Estimated number and level of technological issues and uncertainty and capability to address conservation and water supply goals simultaneously	**High** = few technological challenges, flexibility to achieve dual goals **Moderate** = some technological challenges, flexibility to achieve dual goals **Low** = some technological challenges and some constraints to achieving dual goals **Very Low** = many technological challenges and substantial constraints to achieving dual goals

Table 2-4. Metrics, Tools, and Scales for Evaluation of Planning Criteria (continued)

Metric	Tools	Scale
Criterion #10: Relative costs (including infrastructure, operations, and management) associated with implementing the Option		
P5. Ability to control construction costs for implementing the Option	Cost estimates prepared for construction of component elements and for similar projects under other programs (e.g., DRMS and CALFED)	**High** = cost likely <$1 billion **Moderate** = cost likely $1 to 3 billion **Low** = cost likely $3 to 5 billion **Very Low** = cost likely >$5 billion
P7. Ability to avoid redirected costs to service area from adverse effects of low water quality on municipal treatment, agricultural production, and human health	Rough estimate of cost savings by urban water treatment facilities due to lowered salinity of export water over the next 25 years	**High** = >$2.0 billion **Moderate** = $1.5 to 2.0 billion **Low** = $1.0 to 1.5 billion **Very Low** = >$1.0 billion
P7. Ability to avoid costs for extensive and frequent recovery and repair following catastrophic events	Qualitative assessment of frequency of catastrophic events, costs associated with repair following such events, and effects of disrupted water delivery	**High** = low costs because relatively low risk for infrastructure damage and water supply disruption from seismic and flood events **Moderate** = moderate costs because some infrastructure is at risk of damage from seismic and flood events, but a low risk of disruption of water supply **Low** = high costs because some infrastructure is at risk of damage from seismic and flood events and a high risk for disruption of water supply **Very Low** = very high costs because most or all infrastructure is at risk of damage from seismic and flood events and a high risk for disruption of water supply

Table 2-5. Metrics, Tools, and Scales for Evaluation of Feasibility/ Durability/Sustainability Criteria

Metric	Tools	Scale
Criterion #11: Relative degree to which the Option will be able to withstand the effects of climate change (e.g., sea level rise and changes in runoff), variable hydrology, seismic events, subsidence of Delta islands, and other large-scale changes to the Delta		
F1. Ability of infrastructure supporting conveyance to avoid disruption in water supply resulting from effects of seismic and flood events and sea level rise	Qualitative probability assessment of the conveyance facilities to withstand the effects of future seismic and flood events and sea level rise that would disrupt water supply export. Based on relative risk for seismic and flood events and exposure to sea level rise at Delta locations where facilities may be located	**High** = relatively low risk of disruption in water supply resulting from infrastructure damage following seismic and flood events **Moderate** = relatively moderate risk of disruption in water supply resulting from infrastructure damage following seismic and flood events **Low** = relatively high risk of disruption in water supply resulting from infrastructure damage following seismic and flood events **Very Low** = relatively very high risk of disruption in water supply resulting from infrastructure damage following seismic and flood events
F2. Ability of the Option to avoid loss of restored habitat from future seismic and flood events and sea level rise	Proportion of the planning area that is available for restoration as an indicator of the range of opportunities to locate restoration sites such that the risk of loss to seismic and flood events and sea level rise would be minimized	**High** = 51 to 100% **Moderate** = 31 to 50% **Low** = 11 to 30% **Very Low** = 0 to 10%

Table 2-5. Metrics, Tools, and Scales for Evaluation of Feasibility/ Durability/Sustainability Criteria (continued)

Metric	Tools	Scale
Criterion #12: Relative degree to which the Option could improve ecosystem processes that support the long-term needs of each of the covered species and their habitats with minimal future input of resources		
F3. Ability of the Option to support species conservation without continual input of large amounts of resources to maintain conservation benefits	Estimate of the proportion of the planning area in which Delta flow patterns can be adaptively managed to avoid the need for future remedial habitat restoration; the ability to avoid ongoing mitigation costs (e.g., fish salvage and export restrictions) associated with entrainment of covered fish species	**High** = opportunities to adaptively manage Delta flow patterns in 51 to 100% of the planning area and substantially reduce entrainment mitigation costs **Moderate** = opportunities to adaptively manage Delta flow patterns in 25 to 50% of the planning area and substantially reduce entrainment mitigation costs <u>or</u> opportunities to adaptively manage Delta flow patterns in 50 to 100% of the planning area, but little or no reduction in entrainment mitigation costs **Low** = opportunities to adaptively manage Delta flow patterns in 0 to 24% of the planning area and substantially reduce entrainment mitigation costs <u>or</u> opportunities to adaptively manage Delta flow patterns in 25 to 50% of the planning area, but little or no reduction in entrainment mitigation costs **Very Low** = opportunities to adaptively manage Delta flow patterns in 0 to 24% of the planning area, but little or no reduction in entrainment mitigation costs
Criterion #13: Relative degree to which the Option can be adapted to address the needs of covered fish species over time		
F4. Flexibility to experiment with and adjust water management to address current and future ecological uncertainties to benefit covered fish species	Coarse estimate of the proportion of the planning area in which Delta flow patterns can be adaptively managed to address current and future ecological uncertainties	**High** = 75 to 100% **Moderate** = 50 to 74% **Low** = 25 to 49% **Very Low** = 0 to 24%

Table 2-5. Metrics, Tools, and Scales for Evaluation of Feasibility/ Durability/Sustainability Criteria (continued)

Metric	Tools	Scale
F5. Spatial flexibility for restoring additional physical habitat for covered fish species	Relative proportion of the Delta with high suitability for restoration of physical habitat	**High** = 75 to 100% **Moderate** = 50 to 74% **Low** = 25 to 49% **Very Low** = 0 to 24%
Criterion #14: Relative degree of reversibility of the Option once implemented		
F6. Relative practicability to reverse the Option	Estimated loss of capital investment (based on cost estimates for Option infrastructure provided in the evaluation of Criterion #10) and qualitative assessment of the political feasibility for reversing a Option	**High** = <$0.5 billion in lost capital and likely to be politically feasible to reverse **Moderate** = $0.5 to 3 billion and likely to be politically feasible to reverse **Low** = $3 to 5 billion in lost capital and likely politically difficult to reverse **Very Low** = >$5 billion in lost capital and reversal may be politically unacceptable

Table 2-6. Metrics, Tools, and Scales for Evaluation of Impacts on Other Resource Impacts Criteria

Metric	Tools	Scale
Criterion #15: Relative degree to which the Option avoids impacts on the distribution and abundance of other native species in the BDCP planning area		
O1. Ability to avoid temporary and permanent impacts on terrestrial habitat in the planning area	Coarse estimate of the relative extent of habitat for terrestrial native species that could be removed or degraded with construction of new facilities or modification of existing facilities	**High** = 0 to 250 acres **Moderate** = 251 to 500 acres **Low** = 501 to 1,000 acres **Very Low** = >1,000 acres
O2. Ability to avoid entrainment of other native aquatic species at SWP/CVP pumps under the Option	Coarse estimate of potential change in entrainment of native aquatic organisms SWP/CVP pumps relative to current conditions (based on evaluation results of Criterion #1)	**High** = greater than 50% reduction **Moderate** = 25 to 49% reduction **Low** = 0 to 25% reduction **Very Low** = increase in entrainment from current conditions

Table 2-6. Metrics, Tools, and Scales for Evaluation of Impacts on Other Resource Impacts Criteria (continued)

Metric	Tools	Scale
Criterion #16: Relative degree to which the Option avoids impacts on the human environment		
O3. Ability to avoid disruption of transportation/traffic patterns	Broad-level comparison of the location of new or improved infrastructure under the Option to the location of existing energy and transportation infrastructure	**High** = no substantive disruption to transportation/traffic patterns **Moderate** = local county roads could be closed for a cumulative duration of no more than one year **Low** = local county roads and state highways could be closed for a cumulative duration of no more than one year **Very Low** = local county roads or state highways for a cumulative duration greater than one year
O4. Ability to avoid removal of agricultural land for construction of new facilities under the Option	Coarse estimate of the relative extent of agricultural land that could be removed or degraded with construction new facilities or modification of existing facilities	**High** = 0 to 250 acres **Moderate** = 251 to 500 acres **Low** = 501 to 1,000 acres **Very Low** = >1,000 acres
O5. Ability to avoid reductions in irrigation water quality for agriculture in the Delta	Hydrologic modeling results for Delta water quality expressed as mean annual EC at State Highway 4 Old River crossing and qualitative assessment of selenium loading in the south Delta	**High** = EC <200 umhos/cm **Moderate** = EC 200 to 300 umhos/cm **Low** = EC 300 to 400 umhos/cm **Very Low** = EC >400 umhos/cm
O6. Ability to provide high quality export water for use in service areas	Hydrologic modeling results for exported water quality expressed as mean annual EC	**High** = EC <200 umhos/cm **Moderate** = EC 200 to 300 umhos/cm **Low** = EC 300 to 400 umhos/cm **Very Low** = EC >400 umhos/cm

Table 2-6. Metrics, Tools, and Scales for Evaluation of Impacts on Other Resource Impacts Criteria (continued)

Metric	Tools	Scale
O7. Ability to avoid impacts on other CEQA/NEPA resources (e.g., cultural resources, air quality, noise, and environmental justice)	Qualitative assessment of likely relative extent of effect on each of the resource categories that could occur under the Option based on information available for similar Options previously evaluated (e.g., CALFED) and best professional judgment	**High** = no significant impacts expected **Moderate** = potential for significant impacts in up to two resource categories **Low** = potential for significant impacts in multiple resource categories, but mitigation costs expected to be relatively low **Very Low** = potential for significant impacts in multiple resource categories and mitigation costs expected to be relatively high
Criterion #17: Relative degree to which the Option avoids impacts on sensitive species and habitats in areas outside of the BDCP planning area		
O8. Ability to provide outflows beneficial to species in Suisun Marsh and Bay	Change in average annual Delta outflow during March and April relative to current conditions	**High** = >+10% **Moderate** = +9% to -5% **Low** = –4% to -10% **Very Low** = >-10%
O9. Provides potential for Sacramento, American, and Feather River water temperatures beneficial to native fish species	Shasta Reservoir storage volumes at the end of September	**<u>Storage (maf)</u>** **High** = >1.9 **Moderate** = 1.9 to 1.8 **Low** = 1.8 to 1.7 **Very Low** = <1.6
	Folsom Reservoir storage volumes at the end of September	**<u>Storage (maf)</u>** **High** = >1.5 **Moderate** = 1.5 to 1.4 **Low** = 1.4 to 1.3 **Very Low** = <1.2
	Oroville Reservoir storage volumes at the end of September	**<u>Storage (maf)</u>** **High** = >.4 **Moderate** = 0.4 to 0.35 **Low** = 0.35 to 0.3 **Very Low** = <0.25